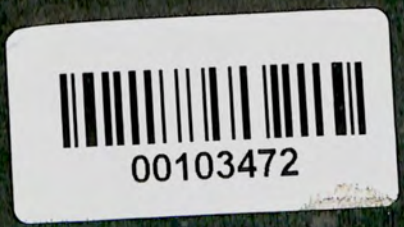
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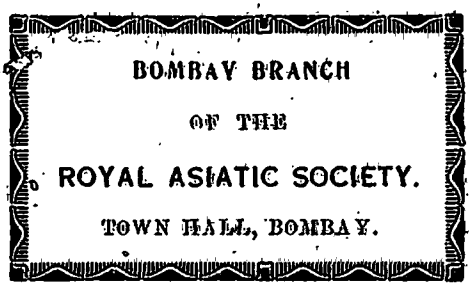


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OF THE

# BOMBAY BRANCH

OF THE

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# PREFACE.

In concluding the Fifth Volume of the Society's Journal, the Editor would take this opportunity of acknowledging, with grateful thanks, the assistance he has derived from the different gentlemen who have contributed to the publication since he has had the honour to be *Secretary* of the Society; more particularly to the Rev. Drs. Wilson and Stevenson, the former *Honorary President* and the latter late *President* of the Society, to whose exertions and willingness at all times to aid in the management of the Society, and the advancement of its objects, independently of their valuable contributions to the Journal, the Society must ever remain indebted.

While availing himself of this opportunity also to apologize for the delay which has attended the publication of the last Number, the Editor would observe, that it has been occasioned by an increase of duty over which he had no control; but he trusts that ere long the Society will, by the assistance of Government, be enabled to provide against such contingencies, and thus find means of insuring that stability and competence in the performance of its *Secretary's* duties, without which the best endeavours of the Society must always be dependent on chance for a successful issue.

*Bombay*, 1*st July* 1857.

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JOURNAL

OF THE

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ROYAL ASIATIC SOCIETY.

JULY, 1853.

ART. I.—*Historical Names and Facts contained in the Kánheri (Kenery) Inscriptions; with Translations appended.* By the Rev. J. STEVENSON, D.D.

Presented 14th October 1852.

IT has been well observed by Mr. Prinsep, that as long "as the study of Indian Antiquities confines itself to the illustration of Indian history, it possesses little attraction for the general student," and that an interest in this subject is only awakened when there has been discovered some "plausible point of connection between the legends of India and the rational histories of Greece and Rome."* Discoveries, however, like those he made, form an era in Indian Archæology. Mr. Prinsep gathered the vintage, and has left to others little more than the gleanings of the grapes; and but for his lamented early decease, his zeal and ardour would not have allowed even these to remain. We have no names of equal interest to bring forward with those already introduced to the notice of the literary public of Europe; no Chandragupta to identify with the Sandracottus of the Greeks, as was done by Sir William Jones; no Antiochus engraved on our rocks by command.

* Journal As. Soc. Bengal, vol. viii. p. 156.

of the lord paramount of India, as in the case of Mr. Prinsep's discoveries. Still we have names interesting to those who wish to follow up the few recorded facts of Indian history, and come to some definite conclusion as to the persons by whom, the purposes for which, and the time about which those remarkable excavations, known as the Caves of Western India, were executed. And as a connecting point with the records handed down to us by the ancients, we learn something of the religious profession of the sovereigns of the *Validior gens Andarae*, who, according to Pliny, had in his time thirty fortified towns, and an army of a hundred thousand foot, two thousand cavalry, and a thousand elephants, ruling over the Mahárâshtra or Great Kingdom, in an extent to which it again in modern times, under the Peshwas, attained and vindicated its claim to the name it bears.

Apparently the most ancient historical name on our rocks is that of the famous Chánakya, the preceptor and prime minister, for a while, of the above mentioned Chandragupta. He is mentioned under his gentile name of Dámila (*Sans.* Drámila). The name Chánakya is a patronymic, and Kautilya ( the crafty), as he is called in the play of the Mudra Rákshasa, is evidently a nickname given him by his enemies. His proper name was Vishnugupta, and Drámila seems to have been a gentile appellation, equivalent to the Sanscrit Drávida, and the modern Tamil,* all of these words being radically the same. In ancient times it is well known that all Brahmans to the South of the Nerbudda were included among the Panch Drávida. When then Vishnugupta left his native town to seek his fortune in camps and courts, his gentile name served him as a surname, in the same way that our French, Scott, Inglis, Cumberland, and many others have become the appellations of individuals. From the two inscriptions in which his name is found, it appears that he was an inhabitant of Kalyáṇa (Callian), and hence not improbably a Koncaní Bráhman of the Chitpawn tribe, who are by far the most numerous class of Brahmans between this and Goa. This is the tribe that, in the Poona Peshwas, gave rulers to the Maráthá Empire, and in Náná Farnavis† produced the most celebrated Indian statesman of modern times, and a perfect Kautilya for his crooked policy. In accordance with the traditions about Chánakya's fame and penance, collected by Wilford in vol. ix. of the Asiatic Researches, it is rather interesting to find

* In the Mahavanso, Dámila is translated Malabarian, though doubtless Hindús from both sides of the Peninsula were included.

† The name of this statesman was Bálaji Janárdhan Bhánu, though, like many great men in India, he is seldom mentioned by this his proper name.

that the only two epithets by which he is described in our inscription (No. 15) are "celebrated throughout the world," and "purified." The two inscriptions contain merely a dedication of a cave to the memory of Dámila, without saying by whom. We are left, then, to conjecture that some one of his descendants, a convert to Buddhism, on entering the priesthood, devoted his property to the excavation of a monument to his great progenitor. The name chosen by which to designate him may be considered a happy one, as it contains a compliment to his native land, while pointing to one illustrious man. From the character of the letters, we may infer that the inscription was engraved shortly after the commencement of the Christian era.

The dynasty that succeeded the Maurya, that founded by Chandragupta, and under the third king of which, A'soka, Buddhism became the state religion in India, is called the Sunga. The founder of this royal house was Pushpamitra. From him the appendage Mitra was confessedly given to some, and was probably borne by most, if not all, of his successors in the same line. It is, although common as an adjunct to proper names on the other side of India, by no means so on this; and therefore there is a presumption in favour of any one bearing such a name belonging to the royal family. The word Mitra is the Mihr of the modern, and Mithras of the ancient, Persians. In Sanscrit it means a friend, and is applied as an epithet to the sun, as being in a special manner the world's friend. In our inscriptions it is to be taken in its original, and not in its derivative sense. Thus the proper name Rohiṇi-mitra literally means the friend of Rohiṇi, one of the lunar constellations, and is a name of the moon. Whatever, however, might have been the rank or family of the persons with Mitra forming part of their name, mentioned in our inscriptions, names of members of the royal family are undoubtedly inscribed on the rocks at Kárle*n* (Carlee). On the obelisk outside the temple there is an inscription, which, when translated, is as follows:—"The chief Agni-mitra (*Prácrit* Agi-mitra), son of the Great King Bhúti (*Prácrit* Bhoti),* erected this lion-crowned pillar." The name of Jaga-mitra also, no doubt one of the same family, is inscribed on the fourth pillar after entering the cave. Bhúti

* In the Mahavanso, C. i. 1, 3, we have *poráno* for *puráno*, and x. l, 26, 29, *sovarno* for *suvarno*; and *pokharo* for *pushkaro*, *passim*. In No. 15 of our Inscriptions there is भो for भू, and in No. 12 भोत as a common noun for भूत. See also Vararuchi, i. 6—9, extending the principle to other words besides those mentioned. The inscription would, indeed, seem to give Goti, instead of Bhoti, but as the *g* and *bh* are very similar, I suppose that either the original artist or the copyist has missed the small distinguishing stroke.

was then, probably, the excavator of this cave temple.* As from Wilson's Vishnu Puráṇa, and Prinsep's Useful Tables, it appears that he reigned about B. C. 70, the cave must have been excavated about that period. Bhúti was accused of immoral practices, and his prime minister, Vasudeva, murdered him, and ascended his throne. Perhaps Bhúti, like the constructor of the first Egyptian pyramid, and the finisher of Saint Peter's, stirred up a spirit of revolt among his subjects by levies of men and money for his magnificent works, and thus his prime minister was tempted to dethrone him, and usurp the sovereignty.

The most important names on our Káṇheri (Kenery) rocks are those of Gautami-putra and Yadnya S'rí-Sát-Karṇi, two famous sovereigns of the A'ndhra dynasty of kings,—that mentioned by Pliny as celebrated in his time,—and perhaps also a third, that of Balin, first sovereign of the race. There is much confusion and many omissions in the Puráṇs in relation to these A'ndhra sovereigns; yet in relation to the two first mentioned kings there is a pretty near agreement. The names in my copy of the Váyu, which was once the property of Colonel Kenedy, and in the Bramháṇda, according to Wilford, agree exactly with the names on our rocks, except that S'rí is transposed, so as to come before Yadnya, which, too, is the usual arrangement. Though the two names follow one another, Yadnya is not said to be the son, but merely connected with Gautami-putra, so that he was likely his grandson. The first of the three kings that reigned between them swayed the sceptre twenty-eight years, and the next two only seven each. These two, then, were in all probability brothers or uncles of Yadnya. The same two names occur again in the same connection at Násik over the cave there most to the right, which is there said to have been excavated by the Commander in Chief of the latter of these two princes. Besides, on the left porch of the great cave at Káṇheri (Kenery) the fragments of the inscriptions show that they there also occupied the same position. From the original Prácrit of Guatami-putra, the Bhágavat has by transposition formed Gomati-putra, perhaps intentionally, to conceal the relation subsisting between the A'ndhra sovereigns and the founder of Buddhism, whose family name this monarch bears. The names of these two kings are so very peculiar, no other persons known to Indian history or tradition bearing either the one or the other, that the bare pointing of them out is sufficient to identify them with the A'ndhra monarchs mentioned in the Puráṇs. It has also been several times noticed by

* True this king in the Puráṇs is called Deva-Bhúti, but Deva is so common a pronomen and cognomen to kings, that its presence or absence is immaterial.

others, that the latter of the above mentioned kings is doubtless the Indian sovereign mentioned by Des Guignes, who sent an embassy to China, and of whom it is specially remarked that he was of the religion of Fo (Buddha), and named Yuegnai.

Another celebrated historical name inscribed on our rocks is that of Buddhaghosha, who is claimed by the inhabitants of the Eastern Peninsula as their apostle, and whom the Ceylonese affirm translated into Páli, or more probably compiled from floating traditions, the Atthakathá, or comment on the sayings of Buddha, after having, before leaving India to visit their isle, published several works in defence of his new religion, and in opposition to his former co-religionists, the Bráhmans.* Whether he ever returned from Siam and Burmah to India, as the Ceylonese affirm, or not, it was probably before his departure that he was connected with Káṇheri ; and as he must have lived about the same time with the first of the above-named A'ndhra monarchs, he was probably, in union with him, instrumental in promoting Buddhism in Western India.

There has been another name of some historical interest engraved on the Káṇheri rocks, which, however, has been obliterated, that of one of the Mahákshatrapas, a race of sovereigns who in the beginning of the Christian era reigned over the country on the Indus and Gujarát, at first apparently as deputies or satraps of the Bactrian or rather Parthian monarchs, but afterwards as independent sovereigns,† who appear to have extended their sway as far at least as Bombay. There is an inscription by a minister of one of them over a cistern at Káṇheri, and a whole cave was excavated at Násik by the son-in-law of one of the sovereigns of this dynasty.‡

In one of the inscriptions we have mention made of a Ságarapála, a kind of High Admiral to protect trading vessels on this, named by Ptolomy the Pirate Coast, an appellation it continued to deserve till the English rooted out those nests of sea robbers.

We have the names of Kaḷyáṇa (Callian), and Wasai (Bassein), and Násik introduced in the inscriptions, and Sopáraga, probably Supa, NE. of Poona, and another town I cannot identify. The hill is called Kaṇha, and is now named in Maráthi Káṇheri.

The persons, then, who caused the caves to be executed were cadets of the royal A'ndhra family, goldsmiths of Kalyán and Násik, and other devotees, who on entering the priesthood thus disposed of their property.

* Mahavanso, chap. xxxvii. near the end.

† Journal As. Soc. of Bengal, April 1838.

‡ Bird on the Caves of Western India, pp. 60, 61.

I shall now endeavour to collect the information furnished by the inscriptions in relation to the design of the caves, and the institutions connected with them.

1. The most important of the caves is that called the Chaitya-Griha (*Prácrit* Chetia Ghar), an excavation dedicated to the reception in ancient times of a dágoba, the representation of the tumulus or mound erected over any portion of the remains of Buddha, and in later times, when image-worship was introduced, of the images of the sage. It may therefore be considered as the Buddhist temple. In the large cave at Kenery, the one probably alluded to in the copper-plate inscription as the Mahá Vihár, we have at the farthest end a dágoba,* and on each side of the porch, in a kind of recess, a colossal image of Buddha, with his left hand raised to his shoulder, and the right with the palm open towards the spectator, in the same way as the Bráhmans of the present day expand the hand when conferring a blessing. This is a favourite posture of images of Buddha, and will be found represented in the first plate of Dr. Bird's work on the caves. There can be little doubt that the two images referred to are those mentioned, in the inscription on the porch, as having been constructed by a relation of the Emperor Yadnya S'rí-Sát-Karṇi. Only the small images at the tops of the pillars are in the interior, and, which being inaccessible here, as in Kárle*n*, could never have been objects of worship, belong to the cave as it was originally constructed. A middle-sized image on the right side, and still in the porch, is expressly said to have been dedicated to Buddha by Buddha-ghosha. There are some smaller images of Buddha, and of several large door-keepers, but all in the porch, and thus it appears, as we shall see more particularly afterwards, when we speak of the chronology, that image-worship was not introduced at Káṇheri (Kenery) till the commencement of the fifth century of our era. In all the oldest Buddhist caves at Ellora, too, there are no images. There is only one complete temple cave at Káṇheri, a second had been commenced to its left, but remains in an unfinished state. The very small cave to the right may also be deemed an exception, where there is a dágoba, as there is also in the refectory of the great cave.

There is nothing in the inscriptions on these caves to lead to the idea, as Dr. Bird supposed, of the intermixture of a Mithraic worship on this side of India with Buddhism. The meaning of the epithet *Mitra*

* Dágoba is a Páli and Singhalese word, supposed to be derived from *Dehagopa*, "that which conceals or covers the body." Tope is a corruption of *Stúpa*, "an artificial mound."

on our rocks has been already explained, and it has been shown that it is used in its original sense of friend, and does not mean the sun. The Buddhist laity paid, indeed, an inferior worship to the gods of the Bráhmans and other Hindús, but not to any one particular deity above the rest. The only two authentic documents on this subject I have been able to find, are the copper-plate above mentioned, and the inscription in the Buddhist monastery at the top of the Náná Ghát, probably, judging from the appearance of the letters, the oldest on this side of India. In the former, besides Buddha, the following objects of worship are invoked :—Deva (Gods), Yaksha, Siddha, Vidyádhara, Gandharva, Ahi (probably Apsaras), Bhadrá-Púrṇá, Bhadrá Padmi, Kávya (S'ukra), Vajrapáṇi (Indra), Vák (Sarasvati), Kánina (Vyás). In the latter inscription there is Indra, Sankarshaṇa (Balaráma), Vásudeva (Krishna), Chandra, Súrya (not Mitra) ; then a name obliterated, after which is Lokapála, Yama, Varuna, Kubera, the Vasus, Ramá, Lakshmi, Kumári, Vara, Sandheji, (Goddess of Twilight ?) S'ri Sarasvati. All these are ancient Vedic gods, or belong to the two great modern sects of the worshippers of Krishṇa and Durgá.

2. The second class of caves are those which were formerly appropriated as convocation halls, and are in the inscriptions named Bhikshu-Sangha-griha (*Prácrit* Bhikhu-Sangha-Ghar). These halls were used by the priests when they discussed religious matters, and were also places of assembly for listening to the instructions of their spiritual superiors.* In one instance at least such a hall was furnished with seats and couches for the sick to rest upon. In the inscriptions on the porch of the great temple the name of eight or nine persons are recorded ; these probably formed a kind of Panchâyat or Committee for the management of all the affairs of the religious establishments at Káṇheri (Kenery) ;—a similar custom prevails at this day in relation to analogous institutions among the Hindús.

3. Intimately connected with these halls were the cells for small companies of priests or individual monks. These are called Bhikshu Griha : sometimes they are cells in the sides of the large caves, and sometimes small separate excavations, entirely detached from all others, and having each a separate entrance. At Kárle*n* they are mostly of the latter description, and at Káṇheri of the former. I think it likely that the word Leṇa, now applied to all of these artificial caves, was first

* A curious set of bronze figures, representing a number of Burmese Rahans listening to their teacher, was lately presented to our museum.

given to these grottoes, and that it is derived from a Sanscrit word which signifies meditation or repose.*

The word Vihár (विहार) which is frequently used, may, I suppose, also be applied to any one of the larger of the above mentioned excavations, but it seems rather to refer to them as tenanted by monks than as mere caves. In fact, it properly means an inhabited monastery, a place appropriated to the pleasurable exercise of religious study and meditation.

4. We have next caves, or portions of caves, devoted to the use of establishments for the supply of residents and travellers with food. These are mentioned under the name they still bear in the country around Annasatra, or its equivalent Satr'sála. Several establishments of this kind are mentioned: if I mistake not, no less than four different such caves are referred to in extant inscriptions. In modern times many Annasatras were established by the Peshwas on the great roads leading to Puṇa (Poona), and those of them that were ancient, and had free (inám) lands for their support, exist to this day. At these establishments only Bráhmans are provided with necessaries, as in ancient times only Buddhist priests were supplied from the refectories. It is the Bhikhús alone who in the inscriptions are invited to come and receive the supply of their wants.

5. Far more frequent mention is made in the inscriptions of establishments for the distribution of water, no less than eight being specifically recorded. Where an Annasatra is mentioned, there is generally, if not always, connected with it a cistern for the supply of water; but there are besides several cisterns not connected with these establishments, as we may reasonably suppose, for the use of those lay visitors who were not entitled to the benefit of the refectories. These cisterns are small tanks of three or four feet wide, five or six long, and as many deep, hewed out of the solid rock on the hill side. They generally are nearly full, and I suppose the water oozes through the trap rock from above, and thus supplies the waste occasioned by evaporation. But there is reason to believe that when the hill was tenanted with monks, there was an attendant present to draw water for the use of visitors, and to fill up the cistern when it became exhausted from the adjoining rivulet, which still exhibits the remnants of broken embankments, showing that the water was dammed back in ancient

* The word is in Pracrit लेणं, and in Maráthi लेणें. The Sanscrit word referred to is लयनं, from the root ली. See Translation of the Kalpa Sútra, p. 107, and the Násik Inscription, No. 13, of Brett.

times, to afford a supply when the tanks failed. In our day it is a common thing in the hot season for benevolent individuals to station a person on the road with pitchers full of water, sufficient to last through the day, to supply travellers who may stand in need of such refreshment. Such institutions are called in Sanscrit Prapá (प्रपा), and in Maráthi Pohi (पोही). In the provincial Sanscrit of one of our inscriptions, they are named Paníya Bhájanya (पानीय भाजन्य), which literally means "a place for the distribution of water." But the name they generally receive in the inscriptions is Podhi, or Pondhi (पोढी or पोंढी), from which the abovementioned Maráthí word is evidently derived. The word पोंढ or पोंढा, in the masculine gender, in the same language, means "the small trench made around the root of a tree to retain the water supplied to it from the well or reservoir in the morning for its daily use," and "a small cistern."*

In my copy of Clough's Pali Vocabulary, (Columbo, 1824,) p. 83, (सोंधि) Sondhi is given for a natural tank or reservoir in a rock. But the reading of our word is too well established from its frequent use in the inscriptions at Násik, and in the other cave districts, as well as at Káṇheri, to permit of any change in the orthography being made. The Sanscrit उदक: water, with the preposition प्र, will give a suitable primitive for our word.

6. At one of the caves, the Chivaraka Káhápaṇ S'ála, mentioned in Inscription No. 10, there was an establishment, as the name intimates, for the distribution to the monks of small sums of money. The word *Chivara* means a rag, or such a piece of cloth as was considered suitable for the wear of a Buddhist mendicant; and *Chivari*, formed from it, means such a mendicant; but from that and another inscription it appears that it was also the proper name of one of the members of the Karṇi or royal A'ndhra family; and I conclude that the foundation from which funds were supplied for the support of this institution perhaps owed its origin to Chivari Karṇi. The copper coin called a Káhápaṇ (*Sans.* Kárshápaṇa) was of the value of $\frac{3}{4}d.$ English money, or about a French sous. It was coined till lately in Bombay, and named there a *dhabbú*, and was in value two pice, or half an anna. According to the Mahavanso,† one article of the Wajji heresy was, that the monks asked the laity, among other things, to give them a Káhápaṇ. Among our Jains it would be contrary to rule to ask such a coin, but not

* The English reader must not here think of our word "pond," for although the resemblance is striking, and there may be a fundamental connection, this is not one of those terms which in later years have been borrowed from our language.

† Chap. iv.

wrong to receive it if offered. Was the asking, then, the gist of the offence, or was the rule afterwards relaxed? It could not, when this institution was originated, be heretical to receive what a public institution was established to bestow. At the ordination of Buddhist priests, also, this is one of the things given them, to indicate that they are thenceforward to be supported by alms.

7. Attached to the monastic establishment at Káṇheri there was a garden producing some flowers and vegetables, and surrounded with a fence. In one of the imperfect inscriptions mention seems to be made of a village (No. 12) attached to the temple, and it is singular that rather a large village called Vihár (the Monastery) to this day exists on the road to Tannah, at a distance of about six miles from the excavations by the pathway; some smaller villages are nearer, but they are among the hills, and poor. A large reservoir of water, with a very old embankment, enables the cultivators to irrigate part of their fields in the dry season, a thing, though common enough in many other parts of India, by no means so on this side the Western Ghâts. It is not improbable, then, that the villagers owe this advantage to their former connection with the monastery. The granting of all the rents of a village for the support of religious establishments is still a common thing in India.

8. The most curious fact of all connected with Káṇheri is the alleged existence there in ancient times of the invaluable relic of a tooth of Buddha. In one of our inscriptions (No. 7) the cave over which it is engraved is called the S'áka-datya-leṇa (साकदत्यलेण), the "Buddha-tooth Cave," probably because the relic was there temporarily deposited, while the tope, there compared to the pole of the heavens, in which it was finally lodged, was being prepared. The final lodgement of the tooth was doubtless in the tope opened by Dr. Bird opposite the great temple cave, as appears from the important copper-plate inscription, of which there is a fac-simile in his work. There must be some imperfections in that copy of the inscription, which prevent it being satisfactorily translated throughout; but its general import is not difficult to ascertain, and that no inspector might for a moment miss its aim, the word (दाढा) Dádhá in very large letters is engraved at the bottom of it. This word means a tusk, or canine tooth; and it is worthy of notice that it is of this species of tooth that the famous Ceylonese Dalada is supposed to be, though in reality it be no more than a piece of ivory. Conceive, then, what a stirring place this Káṇheri jungle, at present the habitation of tigers and of a solitary Hindú devotee, with his cow and her calf, whose domicile is a hut, and cow-

house a cave, must then have been, with crowds of pilgrims flocking in from Kalyán and all the neighbouring cities. It must then have exhibited a scene unexampled now, except at the public exhibitions of the Buddha-tooth in Ceylon, or at Jagannáth, originally, as I have elsewhere shown to be probable, a place of Buddhist pilgrimage, and not unlikely boasting, too, of some relic of the great founder of their religion. It is proper, however, to notice that Dr. Bird did not discover among the valuables he brought to light anything like a tooth.* It is evident, however, from his narrative, that there must have been access to its sanctum in ancient times by some secret door or passage, as a plate in a character more modern by five or six centuries was found in the same mound that contained the one above referred to; nor is it to be supposed that such a relic was inaccessible to the priests, who so highly reverenced it. When the Buddhists were persecuted in India it is nowise absurd to suppose that the precious relic, which could be so easily concealed, and as a bit of bone or ivory would excite so little suspicion or cupidity among Hindú sectaries, was removed, while the gold and jewels, which might endanger the safety of the fugitive priest, were left behind. The Ceylonese tooth is said to have been brought from the other side of India to Ceylon, about A. D. 310. It is not likely, however, if the relic were really carried from India, that it would be allowed to be removed while Buddhism flourished; and as our inscriptions prove it still flourished at least a century later, the Ceylonese may have antedated the removal of the tooth, as well as mistaken the quarter whence it came; so that it is not beyond the bounds of probability that theirs may be our identical Káṇheri relic. The legends, however, relative to the preservation of the relics of the body of Buddha, given in the Athakatha, cannot pretend to authenticity, and it is probable that the worship of relics, as well as that of images, was but a later addition to the tenets of Buddhism.

It would be interesting if we could positively determine who the architects were that superintended these excavations. The only clue we have to this is the mention three times of an artist at Kárle*n* and Káṇheri, who in one of the Kárle*n* inscriptions (No. 11 of Bird) is said to be a Greek (Yavan), and in No. 7 of our inscriptions he is called an artist. He is named Dhanuka-kata, or Dhenuka-kata, which I think may stand for Xenocrates, with even fewer liberties than are often taken in the

* In one of the urns dug out of the mound he says there was "a small gold box, containing a fragment of white cotton rag [query, that in which the tooth was originally wrapt] accompanied by a pearl, a ruby, and some pieces of gold."—*Bird's Caves of Western India*, p. 1.

transference of names from one language to another.* Was he then a Greek or Bactrian architect who superintended the excavating of the great cave-temple at Kárle, and did he seek to immortalize his name in connection with these interesting excavations? It has been long understood that those ancient Hindú coins, which have Greek letters stamped on them, derive their superiority from Greek artists; and Dr. Wilson lately told us that he suspects the superiority of the Adjunta paintings to anything seen elsewhere in India, is due to Bactrian superintendence.

The declared intention of the excavators of the caves generally is respect to Buddha, and regard to his priesthood. But at the same time it is worthy of remark that in five of the longer inscriptions, along with these, the removal of the sins of the donor's parents is a declared cause of the establishment of the religious houses.

The languages in which the inscriptions are written are generally various shades of Prácrit, with a few in Sanscrit. The Sanscrit is more or less pure, but as good as moderately learned Bráhmans now generally write. None of the Prácrit inscriptions approach the Páli in purity, and scarcely equal the Mágadhi of the Jain works, and Hindú dramatic poems. They seem all to have been written in purely colloquial dialects, approaching somewhat nearer to the modern tongues than the abovementioned classical languages do. The general principles, however, of the Páli Grammar, are applicable to them all. The rules of Vararuchi as expounded in Lassen's *Institutiones Linguæ Prácriticæ* will generally enable the Sanscrit scholar to explain the terms that occur, though the Prácrit has various shades, approaching closer, or diverging further from the sacred tongue.

The characters, too, in which the inscriptions are written, vary considerably, according to the age of the inscriptions—as, for example, in the formation of the letters त and न, and also, which is specially to be noted, according to the province of the writer, as for instance in the much greater depth in the Gujaráti character of all the strokes that come below the line, as in अ, क, and र.

The only point that now remains to be touched on is the chronology. In none of the rock inscriptions, as far as I can make out, is there any date, either in words or figures. [Dates at Násik and Cárlee were afterwards discovered, as will appear in a future paper,] but happily this want is supplied by the copper-plate abovementioned, found in

* Most readers are aware of the Wájin Hastin used for Warren Hastings. I was once somewhat puzzled on hearing of a high English authority called the *Sheep*, and not a little amused when I found out that it was the *Chief* that was meant.

the tope opened by Dr. Bird: there plainly in words we read *samvatsare sáta dvy pancha chatvárin sad vttare, i. e.* after the completion of the year two hundred and forty-five; giving us A. D. 189 for the time when the tope was consecrated, and the precious relic deposited in it. The constellation under which this took place was probably Pushya, bringing us to the latter half of June. This is the period of the great festival at Jagannáth, and of our chief festival at Pandharpúr, the commencement of the Buddhist Wasso, and just at the beginning of our periodical rains;* and Pushya is the name of the constructor of the tope.

Buddhaghosha left India for Ceylon according to the Mahavanso Chap. xxxvii., in A. D. 410, and therefore the image he set up in the great temple must have been executed some short time previous to that date, as it seems unlikely that he returned to Káṇheri after his labours in Ceylon and Burma.

Yadnya S'rí, whose name appears in the perch in connection with that of his relation, who dedicated the images there to Buddha, sent an embassy to China, according to the printed copy of Des Guignes in A. D. 408. But there is in this number evidently a typographical error, as the sovereign in whose reign these ambassadors arrived did not ascend the throne till A. D. 424. The date has, therefore, in our library copy been corrected to 428, (I believe by the late Col. Kenedy,) which, being certainly nearer the truth, I shall here consider the true number.† Let us suppose the embassy of Yadnya, called by the Chinese Yuegnai, to have arrived in China in the second year of his reign, which cannot be far from the truth, as he reigned only seven years; then, reckoning back by the help of the Radcliffe copy of the Matsya, cited in Wilson's Vishnu Purán, we are brought to within six years of the conclusion of the reign of the great Sát Karṇi, to whom all the Puráṇs give a period of fifty-six years, as the time when the relic of Buddha was deposited in the tope. If, however, we take the reckoning of that Purán, and begin the A'ndhra dynasty with B. C. 22, we shall be brought into the reign of the Sát Karṇi tenth on the list.

* See for the basis of this calculation Bently's Hindu Astronomy, and Prinsep's Useful Tables, p. 18, part ii. The latest day was June 29th, as the Hindú year began on the 23rd January from A. D. 44 to A. D. 291. As the luckiest day is the earliest, we conjecture the date to have been June 16th A. D. 189.

† The original in Des Guignes, vol. i. p. 45, under the reign of Tai-tçou Ven-hoan-ti, who is said to have ascended the throne in A. D. 424, to have died in 453, and to have reigned 30 years, is as follows:—

"L'an 408 on voit arriver à la Chine des ambassadeurs du pays de Kia-pi-li (*a*) dans l'Inde, où est le Mogol, avec des presens pour ce Prince."

(*a*) "Le Roi se nommait Yue-gnai. On remarque qu'il suivit la religion de Fo."

## SANSCRIT INSCRIPTIONS.

### I.

The most important of the Sanscrit Inscriptions is No. 2 of Mr. Brett's fac-similes, and No. 6 of plate xli. in Dr. Bird's work. It is under the middle-sized image of Buddha in the recess of the porch of the great cave on the right. In Devanágarí it is as follows :—

बुद्धस्य भगवत शशासनान्यकारीति पीडको पाध्याय
भदन्त धर्म्मचित्य [स्य] शिष्यस्य शाक्यभिक्षुबुद्धघोषस्य
सञ्चागन्तो [:] कुडिवारिकस्य भगवत्प्रातिमेय देयधर्मो:

*Translation.*

A religious assignation of an image to the lord (Bhagavan) by the compassionate teacher and venerable monument of religion's disciple, the S'ákya mendicant Buddhaghosha, a sojourner on earth, and a prisoner in the body; the same who composed the institutes of the lord Buddha.

*Notes.*

The letters in brackets are supplied, where letters seem to have been obliterated. Between का and रो in line 1st Dr. Bird has a letter, and Mr. Brett none. The space seems somewhat large, but on personal inspection I could hardly think that it ever had had a letter engraved in it. The first supplement, especially as the preceding letter is doubtful, does not give me entire satisfaction, but it is the best I could think of.

The word पीडक is here taken passively, and means he who suffers from sympathy with the griefs of others, from पीड in the sense of compassion. प्रातिमेय the Brahmans say is not according to the Kaumudi, but the rules were perhaps not then so strict as they are now. देयधर्म it may be as well to mention once for all I understand to mean "a thing dedicated to charitable or religious purposes." In Marathi दानधर्म means charity in the sense of almsgiving, properly "the religious act of giving."

### II.

This inscription, which is No. 6 of Mr. Brett's, is imperfect, and the first line so nearly obliterated that Mr. Brett has not attempted to take it. An attempt was made by Dr. Bird, when probably it was less broken, and the result will be found in Plate xli. No. 8 of his work. There the inspector will observe something like the word Kshatrapasya,

and from the form of the letters I have no doubt they belong to the Gujarát type. The language is an attempt at Sanscrit, but can scarcely be called pure. The last line is as follows :—

वस्यधि आमात्यस्य श्रतेरकस्य पानीय भाजन्य देयधर्म्मः

*Translation.*

The charitable establishment of a place for the distribution of water, by S'ateraka, the Minister in the Bassein province of the Satrap.....

*Notes.*

This inscription is over a water tank, but it appears that visitors had water served out to them. The letters च and यो I particularly examined personally, and think they are correctly given in Dr. Bird's plate.

PRACRIT INSCRIPTIONS.

I.

The first of these, or No. 1 in Mr. Brett's fac-similes, is inscribed on the inner wall of an open verandah-looking place just to the left of the great cave, and which the visitor reaches before he comes to the temple. At the outer edge of this court are two cisterns ; in the inner wall there are two excavations, forming small rooms, with raised benches, exactly such as are now in India constructed for the fire-place in cooking-rooms. Over the one of these most to the left is the following inscription :—

कल्हियण सुवणकरस समिद्दाभस सहसायण पनिक देयधम

*Translation.*

The religious assignation of a cistern, fitted to last a thousand seasons, by Samidábhá, a goldsmith of Kalyáṇa (Callian).

*Notes.*

The word पनिक is peculiar to this inscription, yet it is evidently derived from पानीय, which is found in the place of it above. The word सहस (thousand) is to be taken as expressive of an unlimited number.

II.

This is inscription No. 3 of Mr. Brett's, and is only a little to the right of the above, over a second small room, similar to the one before described ;—

नासिक कंसण कणकस सत देयधम

*Translation.*

Peace. The religious assignation of a refectory by Kaṇaka, a brazier of Násik.

*Notes.*

The figure Svastika, which I have rendered *Peace*, is a lucky figure among all Hindús, and especially among the Jains. If the Chinese authorities regarding the existence of Doctors of Reason, whose emblem was this mystic cross, before the time of Buddha,* are to be depended on, these could be no other than the Jains, to whose sect, and not to the Buddhists proper, the naked sages with whom Alexander the Great came in contact, and one of whom, Calanus, followed him, evidently belonged. The Jains existed three hundred years before the Buddhists,† and this may have given rise to the double Buddhist chronology: the one being an approximation to the time of Parshvanáth, the founder of Jainism, and the other to that of Gautama, the founder of Buddhism. कंसण is an unusual form for an appellative, but is evidently derived from कंस ("brass"); it may, however, be a part of the name. The word सत is for सत्र, a place for supplying necessities to mendicants, as before explained. The small rooms apparently were the kitchens, and the large covered space, open in front, the dining room.

III.

This inscription (No. 18) is in one line under a middle-sized image of Buddha, on the screen of the great cave that divides the hall inside from the porch, over the heads of the door-keepers on the left.

ओम् देयधमो येग्राक्यदिक्षा धम्मस दृश्य

*Translation.*

To the Triad. A religious assignation to those (or from those) who are eminent among the followers of the S'ákya religious discipline.

*Notes.*

I have hesitated whether I should rank this among the Sanscrit or Prácrit inscriptions. If the third syllable from the end can be read श्य instead of स, all the other changes may be readily made to reduce it to Sanscrit; the termination at the end also being supplied. The mark for the invocation is a figure, almost, but not quite, a circle, with the tail continued so as to make nearly, in addition, a

* Jour. Royal As. Soc. of London, No. xii.

† Kalpa Sutra, Preface xii. to xiv., and Trans. Royal As. Soc. vol. i. p. 522.

semi-circle, concentric with it: I think it is an ओ, as it resembles not a little that letter in some of the Southern alphabets, and in the Maráthi, as written by children on their sand-boards, for this invocation only.

IV.

N. B.—The inscription No. 4 of Mr. Brett's fac-similes, being much broken, will be given after Nos. 11, 12, and 13, from which it can be so filled up as to convey its general sense.

The inscription No. 5, and iv. of Plate xl. of Bird, is engraved on a small dágoba, cut out of, but not separated from, the left wall of the porch of the great cave, just as one enters. Over the dágoba are three umbrella-shaped figures, rising one above another; and two human figures, leaning upon the second, are laying hold of the third. This is probably a representation of the three worlds, and of devotees escaping from earth to heaven.

The inscription is—

ये धम्मनाहिंस पूतव तेषां

*Translation.*

(The image) of those who, by religion, have become guiltless and pure.

*Notes.*

The translation, perhaps, should be "(Dedicated) to those" &c. The ना in this inscription has an unusually curved lower limb approaching the form where it becomes circular. Harmlessness would be a literal translation of अहिंसा, but no English word can convey its force. It is one of the cardinal virtues among Buddhists, Jains, and Bráhmans, and prohibits the killing, or in any way injuring, any living creature.

V.

This inscription (No. 7) is in the first cave on going up the hill from the great cave to the first tier of caves on the left bank of the nála or rivulet. After ascending the steps, however, the visitor must turn to the right, so as to come back again till he is almost over the place from which he started, to find this cave.

सिधं कलअणकस नेगमस गोलीणक पुतस नेगमस ईसिहलस
सपरवारस मता पितुण
पयथ लेण पोढीवदेयध
म ॥ अखय निवि वदी णगम
स फउ सुखेते बलति धवे
च वासउथ सवे वखू कुबरस क
तिन्हि सुपटे किम् से से से ख
मट लप वटुवपल अभिन्नव

*Translation.*

To the Perfect One. The religious assignation of a cave and cistern by Rishi-hala, skilled in sacred learning, son of Gaulinaka, of the city of Kalyán, skilled in sacred learning, along with his attendants, to atone for their parents' sins. An inexhaustible treasure is here deposited, and the tooth of the venerable personage skilled in sacred science displays its influence in the holy field under the pole-resembling monument. What then, O! ye monks, who keep the appointed sessions is there distinguished in the workmanship even of Kubera, or in the most splendid apparel? Happy is the man of subdued passions, whether a religious student, or one who has a perfect knowledge of the times.

*Notes.*

The letters of this inscription are often indistinct, though it is not in the least defective. The ष of सिध looks like a ब, and in the sixth line we have, I suppose, वखू for भिखू and कुवरस for कुवेरस. I am very doubtful about these two words, however. पयय in the beginning of the third line I take to be a corruption of प्र यश्च, in the sense of प्रायश्चित्त; नेगम, which occurs so frequently in this and other inscriptions, is the Sanscrit नैगम (Vararuchi i. 34), and should mean the same as वैदिक—"one skilled in the Vedas," but is given in Wilson's Dictionary "a sectarian, not a heretic." There can be no doubt of the correctness of so guarded an explanation, and, therefore, with the radical meaning of the word, it suggests that at one time there were Bráhmans skilled in the Vedas, who were sectarian, though not heretical. But our inscriptions teach us that these were Buddhists; therefore at one time, in the eye of the other Bráhmans, those who joined the Buddhists were not viewed as heretics, more than persons who now become Gosáins or Bairágis, but were merely looked on as sectarian. This supposition, also, is useful in explaining the intercourse between the two parties exhibited in the play of the "Toy-cart." If the reading in the end of the fourth line is correct, it is to be explained from Vararuchi ii. 41, as usual. The word निवि, joined with the epithet अखय, is very frequently used, also, in these inscriptions. It signifies properly "capital stock," and means, as appears from the inscriptions at Násik, Nos. 6 and 7, to have been a sum of money not to be touched; I suppose, except in extreme cases. फड may be derived from फट, a tooth, as पद्म becomes पडम, and analagously मद : मओ; Vararuchi iii. 64, and ii. 2. चन्दो is चंद्र, as रात्रि : becomes राई. To those acquainted with the Sanscrit the other substitutions, as खमट from क्षमित, &c. will readily suggest themselves from the translation. On the last word compare

Esther i. 13, पल being taken for time in general. The से thrice repeated is singular, but it may be intended for सेयस or श्रो I imagine.

## VI.

The inscription No. 8, which is over a cistern, next follows :—

खमलकस हेरणकस
रोहणो मितस पुतस
सुलासदतस पोढी
देय धम ॥

*Translation.*

A religious assignation of a cistern by S'ulása-dat, son of Rohinimitra, a goldsmith of Khamalaka.

*Notes.*

The name of the abode of this donor is doubtful, and the first letter may be ख or चे : according to either reading, however, there is no place now in existence with which I can identify it, unless it be a town between Satára and Puṇa called Karmala.

## VII.

This is No. 9, and of the same nature as the preceding :—

सापारगा नगम
स समि कुपासक
स पोढी देयधम

*Translation.*

The tank of Samyakupásaka, skilled in sacred learning, of the town of Sopár. A religious assignation.

*Notes.*

The name of the donor here means "constant devotee." There is a considerable town thirty miles beyond Puṇa to the south-east, called Súpa, or Sopa, but whether this be the town intended or not I cannot say, yet no more probable identification suggests itself. There is a Rakshasiṇ mentioned in the Ramáyana called शूर्पनखा, from whom the name of the village is probably derived. In reference to Negam, the term here applied to Buddhists of the Bráhminical caste who had studied the Vedas, I may further observe that it is quite unknown among the Maráthi Bráhmans of the present day.

## VIII.

This is No. 10 of Mr. Brett's inscriptions, and has, from the fracture of the stone, a good many blanks.

[सिधं] उपासकस धेनुककटिनस कलप
[नक]मणकस ठतय पवद्दतिकय सप
रण भद्त बोधकाण पणकाण अतिवासी [ण]
लेण देयधम पाणीय पोढीच सहाभभो
रति निकाय सहच सवेण जतिस ध [मना]
चतुदिसे भिखु सघ अथ आपुट [भि]
खुआ पतिठापित मतपितर उनीस सव [हारक]
हित आघथ भिखुसघस अखय निवोच द्[ता धम]
सघण चिवरिक द्त व सला साक द्त्य ले [ण]

*Translation.*

[To the Perfect One.] The religious assignation of a cave and water cistern, by Dhenukakati, (Xenocrates ?) the architect, for the disciples of the stable, holy, perfect, reverend Buddhist teachers, along with the company of those entirely freed from fear, and also for all who follow the self-denying (Jati) religion. O ! ye monks in the four quarters (of the world), now a shelter has been provided for monks [to cancel] the debt of my parents. Come then hither, ye mendicant priests : here an inexhaustible treasure is deposited for the priestly assemblies ; here is a hall established for Buddhist priests ; here, the Buddha-tooth-cave !

*Notes.*

The name of the donor in this inscription is the same as that on the Kárle*n* rocks ; the first syllable here has the vowel *e*, it is sometimes *a*. I have previously made remarks on it. The concluding word of the first line, and commencing one of the second, I understand as modifications of कल्पन and कर्मन् ; the latter is according to Rule iv. 7. The former, however, should be कप्पन. The words of the second line I understand as corruptions of स्थातृ or स्थोत, पविचकृत् and संपूर्ण, though none of them square exactly with the rules.

The word अभभोरति I translate as if it were अभभीरतीत. The Jati religion is now a common name for the Jain religion, but in our text it must mean the Buddhist, to which the word may be equally well applied. The idea of debt in the sense of sin is found in the old Maráthi literature, and is no novel expression introduced by Europeans. In Maráthi ऋ becomes as readily उ as द्—हित for hither is Koncáni

Maráthi to this day. In आघथ we have the Sanscrit ग changed to घ, as in the case of घर. (Vararuchi iv. 39.) After साक, for शाक्य, the त is peculiar, and has a turn to the right instead of the circular termination, which it commonly has in this inscription. This I have taken as a य, which, if it were used, would be marked something in that way. Perhaps it may be the mark of elision, and then the Devanágári should be द्त्. Whichever way it be taken, I cannot conceive of any other meaning so probable being intended as that given in the translation. Chivari of the royal A'ndhra family is mentioned particularly in No. 12 of Mr. Brett's fac-similes, our tenth Prácrit inscription, but here I have taken the word as an appellative. (See Wilson's Sanscrit Dictionary.)

## IX.

This, which is No. 11, and the next, which is No. 12, follow each other, with a short space intervening, over a small cistern in the porch of a large cave, still on the left bank of the rivulet, and still farther towards the south than those mentioned above :—

सिधं कलय [ णकं ] वस [ योक सा ] यणसवमतस पुतस नेग
मस धम [ नकस उपासकानं ] बुधकानं सहच सवेण परिवा
रेण पाव [नाय ठापिता] पिलेण पाणीय पोढी आसण पेढिका
योपाधे अ [ थेमं ] च कमोच देय धम चातु दिसे भिखुसघ ह
ति ठापित मातपितरो उद्दिस सवत हित आघथ
एथचे अखय निवीच दता

*Translation.*

To the Perfect One. The religious assignation of a cave, a water cistern, a seat, a cupboard, and a row of couches for the sick. These have been [bestowed] for the sancti [fication] of religious [devotees] and wise men, along with their attendants, by Dharm [anaka] skilled in sacred learning, son of Sayána Sarvamata of Vas [ai] (Bassein), near Kaly [án]. Come hither all ye monks from the four quarters (of heaven) to the house established from regard to the (donor's) father and mother. Come hither from every quarter, for here, too, is deposited an imperishable treasure!

*Notes.*

The distinguishing of a town from others of the same name by mentioning some other place near it, is very common at this day among the Maráthas. Near the beginning of the third line the transcript has बव, which I have converted into पाव, by the slightest

imaginable change, as will appear to those who know the ancient characters: of the above combination I could make nothing, and the idea of sanctification for the priesthood is common in the Mahavanso. पेढी in Maráthi is the small raised earthen or wooden platform on which Shroffs deposit their money. I have conjectured that it is a kind of cupboard, for placing any articles on not in immediate use. उपाधि in the contracted form of उपाध is common in Maráthi for a tedious harassing sickness. The Maráthás frequently prefix the semivowels य and व to words opening with a vowel; in some districts it is done always. उद्दिस I consider to be उद्दिश्य in the sense of "having regard to," for which Maráthi Bráhmans use उद्देश करून. हित "hither," एथ "here," and च "even," "also," are common Maráthi words; the two former provincial, the last classical.

X.

See for the position of this the last number.

एतोच वासारते वसतस भिखुणो चिवरक कहापणा सालस पातेल
स उपाहण च कहापणो दत किलिं [जक] पडिकमा सेव सभासदा
नवासे सेण्णांलेण पडि अभित वरालयणे विहारे गंधारिका भूमी
य वगभ भोजण चातसालच देयधम एते सपिअख निवि दता मुकदसीव
थिय निवेसण एते बे भाका विगभस भाका चातसालस विहार दसकानो चिवर
कानो चातसाल चतक

*Translation.*

Here, in the lofty day and night lodging-place for monks, is the Buddhist mendicant alms-house, in which the use of cooking-vessels is given, also money and mats for the multitudes that attend for the confessional service, during the time of the annual session connected with this cave; also on both sides of the monastery is ground filled with champaca trees, and swallow-wort, and also a refectory in the outer court; all a religious assignation. Here, too, is the beloved inexhaustible treasure, the procurer of final liberation, in a most excellent apartment. Here are two charitable establishments; the square refectory connected with the outer courts of the monastery and the painted square lodging-place endowed by Dasakarṇi and Chivari Karṇi.

*Notes.*

The word Chivari means a Buddhist mendicant, and is derived from चिवर, a rag of cloth, or such a plain garment as a Buddhist priest may wear. In the conclusion it appears that Chivari is the proper name of one of the A'ndhra royal family, whose surname was Karṇi; but

at the commencement I take it as a common name. In the preliminary observations Káhápaṇ (*Sans.* कार्षापण) has been already explained. The word पानेलें is Maráthi in the sense given in the translation. I have given the Jain meaning of पडिकमण (*Sans.* प्रतिक्रमण,) to पडिकम, though without independent Buddhist confirmation. The Jains have a regular annual confession, but I have not heard that modern Buddhists have any such custom. They might, however, have had it in ancient times; but if the sense given in the translation be objected to, some such general idea as waiting on religious instruction may be substituted, though that does not suit the derivation of the word so well. The tree and plant mentioned in the text are both highly esteemed by the Bráhmans of the present day—the latter is the *asclepias gigantea.* गर्भ is the sanctuary of a temple or interior of a house. I understand विगर्भ as the veranda or outer court. The reading बगभ is probably corrupted. Of such corruptions as यिय for ईश्व and चतक for चिचक I can only say that the former would pass in Maráthi where य is frequently prefixed to vowels, and that in the latter the ट् is probably obliterated. बे is the modern Guzeráti for *two,* being the Sanscrit द्वि corrupted. We have here another A'ndhra prince, Das'akarṇi, connected with the caves. This large monastery still retains some marks of having been plastered and painted.

## XI.

This inscription (No. 13) is in a cave on the opposite or right side of the rivulet, a little higher up than the preceding, and nearly in a line with the Gosain's house.

This is No. 14 of Plate xliv. of Bird.

सिधाय
राज्ञ गोतमपुतस सम सिरी यज्ञ सतकणीस [ नगरंद ] पुत
न्याण पधतिक वसई कलियण वाथवस नेगमस अण
जपुतस उपासकस अपरेणुस सपरिवारस सह
कुटुबिणीय आणद माताज वरिटिकाय सह धुलकणी अणदणीठ
सह चतुकन्या हीजरणा ..... सहेव धमदवय
सह ..... एते अह वीज्य लेण आमपितर लोस
पावत कणह [ से ] ले लेणह कटो चदेय ठाव चाउ दिस
भिखुयाथे पटिठापित सव सभणी हित आधथ ॥
एते सच अखय निवि दता काहापणा, नसतो नित्य गुरो
सघसये वाहये पडिके सते एथच आधपण
खेतयस खेतगामे मगल थने भोज्यक पत एते
सघण दतव चिवरिकस दूस कपर्दिक चमसो ऋतुलेका

*Translation.*

To the Perfect One. King Gotamiputra's imperial (descendant,) S'rí Yadnya Sátakarṇi had a nephew named [Nagakanda] and surnamed Aṇa, who had abandoned the world, and was skilled in sacred learning. By his son Apareṇu, (surnamed) Aṇaja, a devotee, along with his attendants, and also by the most excellent A'nanda, son of the lady his mother, along with Dhulakarṇi, A'nanda's guardian, and four daughters, Hijaraṇa ——, ——, ——, along with Dharmadravya and also ——, this cave and screen, destined for worship, were formed and bestowed as a gift in the Kaṇha hill to cover the deficiences of the (donors') parents; and to be a place for the benefit of monks from the four quarters (of the world). Therefore come hither all ye multitudes. *Peace.* Here is the true inexhaustible treasure, here is an establishment for the distribution of money and the supply of provisions. To the spiritual directors during their session in the rainy season is given to each daily a hundred groats. Here also is instruction in medicine, and at the beautiful spot called Field Town a supply of vegetables. Here is the delight of the assembled priests, the matted-hair ascetic's cooling-herb, useful to monks at particular seasons.

*Notes.*

The first line, though indistinct, is probably as I have given it, सिधाय; पुतण्ण, doubtless ultimately from पुत्र, is the Maráthi word for nephew.* वाथवस I understand to be वृथावास, "living at ease," as वृथाट्या means "travelling for pleasure"; but from the Násik inscription it must mean an ascetic. Doubts attach to some of the proper names given, and some are obliterated. The name of Sáta Karṇi's nephew is taken from the next inscription, where it is unambiguous. हिजरणा I would interpret as हियाराणी, "Queen of the heart." लिस is for लेश, "deficiency," and पावत for प्रावृत, "a covering." वाहथे is for वार्षार्थे, as कार्हापण is from कार्षापण, पडिके is for प्रतिके, which is the adjective of कार्षापण in Wilson's Sanscrit Dictionary. अधपण is for आध्यापन. The भोज्यकपत्र may be vegetables generally, or the aromatic leaf chewed with betelnut, lime, and cloves, by the natives of India.

The last line, if the words be brought back to their Sanscrit forms, will stand thus:—अत्र संधानंद्वान् चिवरी सदृश्यः कपर्दिक चमसो ऋतुकाले. The चमस is in Hindi called Khetpápadá, and in Maráthi पित्तपापडा.

* In this, and most instances where the Maráthi is referred to, Molesworth's Dictionary will confirm what is said, though, residing more than a quarter of a century among the people, and speaking their language, I can speak from personal experience on this subject.

and is cooling and antibilious. In reference to the name कपर्दी, and the votaries of Siva, who wear matted hair, see As. Res. vol. xviii. I have assumed that these sectaries had an existence in the early centuries of our era, which I believe them to have had, though perhaps not then acknowledged, even in the partial way that they now are by the Bráhmans here. For ऋतुकाल see Wilson's Sanscrit Dictionary. The Sanscrit of the rest will easily appear by supplying the nasals, and changing अ to आ, or *vice versâ*, and keeping in mind Vararuchi's rules.

## XII.

We are now prepared to examine No. 4 of Mr. Brett's fac-similes, that of the inscription on the left porch of the great cave, as from the last we shall be able to supply enough at least to lead us to its general purport.

This is No. 11 of Plate xlii. in Bird.

राज्ञ गोत [ मो पुतस समसिरी यज्ञ ]
सातकणीस्स [ नग कन्द पुतण्यस एत ]
म्ही पखीपच [ रवने उद्यान खेत च ]
वाणीज केषिउत्त [ न्नाय च अन]
ज्ञ.य उपनेषी गा [ म पदतं च ख ]
गोतियेहि भातु [ र आनंदेन सह ]
गाजसेनेन सह गज मि [ ते न सह ]
कापिलेयो चेति [ या ठापिता देयधम ]
आचारिया न निका [ यान च उपा ]
धियान परिगसेह [ सतसाला मा ]
तपितून असूतिन [ पटिठापिता ]
अजेया कुटुंबिणी [ या जनि ] त बाल
सव हेतुस भातिनेयि नंदि [ न ] स
वगस च अगो पटि अ [ गति ] य सव्वत
च हित सुख घहे तुठुथ चनव
कालवजिन थेरा भदंत अचला भद [ त ]
गोपलो भदत विजयमितो भद त बो
भद्त धमपालो उपासको च नगकद
पुत अपरेणु तु समपिता अचरि [ यो तु ]
भद्त सेहलो भसो भोत उपकारिमान भ
दता ठठिकेन कण्ह सेल वंदके परिखित
सेलि कोटि च केहि सह कटके चरित आ
कोणा व मिठिकेन

*Translation.*

King Gota [miputra's imperial descendant S'rí Yadnya] Sát Karni

had [a nephew named Nagakanda, who in the forest] frequented by the feathered tribe [reclaimed land for a field and garden] to obtain groceries and agricultural pro [duce]; and also bestowed the neighbouring vill [age] of An [anga] for the benefit of his kindred; and in union with his broth [er Ananda, and along] with Gajasena and also Gajami [tra dedicated as a religious assignation two] images to Buddha. [Here was established also a refectory] fenced in and adorned with figures of lions, for the company of religious teachers, for the purpose of putting a stop to my parent's transmigration. On account of all the children [descended from] the lady Ajeyá and my brother's sons and family, come ye from every quarter to this mountain house, and enjoy a happy home. Here nine death-subduing priests of established virtue, (Theros,) the venerable Achala, the venerable Gopal, the venerable Vijayamitra, the venerable Bo, the venerable devotee Dharmapála Aparenu son of Nagakanda, and Samapita the religious guide, the venerable Sehalo (Sinhala?) along with a body of other eight venerable priests, filled with great compassion towards the world, reside in the sacred Kaṇha hill, on whose circumference grows the mountain pepper, which is enclosed with a circle of prickly pear, and filled inside with turmeric, the delight of sages.

*Notes.*

The filling up of the proper names at the beginning is, I think, placed beyond doubt when we refer to the last inscription, and consider that the letters added exactly complete the line. It will be observed, also, that the name of Sát Karṇi's nephew is taken from below, line 18, where it is uninjured. So much filling up is required, that the translation, beyond the proper names, is not much to be depended on. Yet I think it will be conceded as probable in connection with the word वाणिज for वाणीज्य and केषि for कृषि. The supplying of म to ग to make out the word for village is not surely unwarrantable, as in the former and in the Násik inscriptions it is plainly given in full. कापिलेयो must, I think, be interpreted as an epithet of Buddha, whose favourite abode, Kapilavasta, it refers to; and the चेति we have had so often for the first letters of the word चैत्य, that little doubt can be entertained of this being the word intended. Among the Jains the word चैत्य applies even more frequently to "an image" than to a temple, though its original meaning was probably a "Dagoba." The lady Ajeyá seems to have been Aparenu's mother, but as Ananda was his *Mátája*, "half-brother" only, she must have been married twice. भसि I understand to mean भृशं, and भोत to be for भूत, as at Karlen

King Bhuti is called Bhoti. Some difficulty has been felt with the last two lines, but a comparison of the transcript with the translation will best enable a Sanscrit scholar to judge how far I have hit the sense. I have not thought it of sufficient importance to say anything in its vindication. Besides, except केहि for केशि by an extension of Sutra ii. 43 to other words than those mentioned, the changes are regular.

## XIII.

This inscription is more broken, apparently, even than the last. It is on the right porch of the large temple, and one cannot help suspecting that at the time of the Buddhist persecution, both were purposely injured, as large pieces from the stone have been wholly detached. Owing to this circumstance this inscription here begins in the middle. Mr. Brett did not take it at first with the rest, but as it is important in connection with the preceding, I have made a transcript and translation, as far as I can, of what remains; and Mr. Brett has also since taken a fac-simile of it. It is numbered 10 in Plate xlii. of Bird's.

.....
.....
.....
[ ..... दिवा ] ख भा लंकरेसु आलं
[ कृत ..... र ] खकस चेति अस गे
[ हे ..... घम ] लंकर सचबुधयि मुनया
[ नं ..... ] अखय निवि दत्ता सेपारक हारह
[ र ] नोई कालिअणेअ बालिका विहारे चेति
[ अ घ ] र पधान साल देवर काणो पति ठाणे विहा
[ य ] द गुहस दरिय चेतिअ घर देवर कांतरेस
स अख निविक [ य ] जनत लोक पइठाणपथे
रसणे धुलि कणोय कदर कोठीच वणिता सदा
सेवा न्याया [ घ ] रा सघ रामास अखयनिविक क
राचित प [ ति ] मा देयधम नीचे अनानि सिरे रतानि

*Translation.*

The following religious assignations (belong to this locality). Adorned with a radiance vieing with that of the solar rays in the —— preserving sanctuary constructed for Buddhist sages, by——, the glory of religion, is deposited an inexhaustible treasure, all-protecting, and delivering from rapine. In the prosperity-ensuring monastery of Balí there is, connected with the temple, the hall for travellers. On the site belonging to the divine Karṇi there is the heaven-bestowing cave-

temple of the glen. There is, near the pleasant road close to the site of the divine Kántera, where the people worship the veritable treasure relic, Dhuli Karṇi's granary and store-house. Above all, there are the famed veritable treasure images which sustain worship and virtue, and are beloved by the priesthood, with the hand in the attitude of bestowing blessings. Below there is food ; above there are jewels.

*Notes.*

The intention of this inscription seems to have been to recite the different institutions at Kenery established by the Karṇi family, and to exalt above them all the two colossal images of Buddha, mentioned particularly in the last inscription. Probably it may be possible, by-and-bye, to identify the places here spoken of. प्रतिष्ठान is written पतिठाण and पइठाण ; when applied to the celebrated city of that name the Maráthas write it पइठण. Here it is to be taken as a common noun. The word देवर in Sanscrit means "a son-in-law." In old Maráthi the termination र was common, and it is still used in respect of some words. It prevails also in the Telinga language, and I conceive र here to be a termination derived from that source, and the word to be rendered, as it would be in Telugu, "divine." According to the Bhágavat, the first A'ndhra sovereign was named Balin, and Balika will then be an adjective derived from that name. I think it probable that he is here referred to ; yet, except for the epithet divine, the name itself is too common to fix anything ; and, perhaps, it will be safest at present not to lay down anything as certain on this head, since Kantera, who has the same epithet, cannot readily be identified with any of the Puranic sovereigns. The concluding part—that which mentions the images—is the most important part of this inscription. कइर is for the Sanscrit कृदर, the ऋ passing not only into रि, but also into उ and अ.

In comparing the transcript accompanying this paper with Mr. Brett's fac-simile lately made, the following differences appear :—

Line 2, letter 1st, अ is given for ख, and the last letter is भ ; line 3, the 5th and 6th letters are omitted, and blanks supply their places ; line 4, the 6th letter is omitted ; line 5, the 6th letter has more of the णे ; line 8, the last letter is simply थ ; line 10, letter 3rd, the न्य is more distinct ; in the last line the 5th letter from the end is broken, but must be पि or हि ; the next two have their heads also broken, but must be क or र. Some slight changes in the translation may be neccssary if these readings in the second and last lines are adopted.

XIV.

This inscription and the next belong to Chánakya. They are numbered by Mr. Brett 14 and 15.

सिधं कालियणिकय भिखुणीय दामिलाय
लेण देय धम

*Translation.*

To the Perfect One. To Dámila, the mendicant ascetic of Kalyáṇ, the religious assignation of a cave.

XV.

सिधं कलअणिकाय भोद्भियाअ
पवद्तिकाय दामिलाय लेण
[ पो ] ढी च कण्ह सेले देय धम

*Translation.*

To the Perfect One. To Dámila, inhabitant of Kalyáṇ, famed throughout the world, and purified, the religious assignation of a cave and cistern in the Kaṇha hill. Peace.

*Notes.*

The only question that can arise in regard to these two inscriptions is—do they refer to the famous Dámila, or to some obscure Buddhist priest? I suppose the cave referred to to have been constructed a considerable time after Chánakya's death, as a monument to him by one of his descendants; and as to Chánakya being represented as a Buddhist priest, the collection of traditions made by Wilford respecting him, in the Asiatic Researches, vol. ix., shows that he finished his life as a penitent at the least. The modern Bráhmans, of course, would never allow that such a character became a Buddhist, whatever the fact might be; and one of his descendants might very naturally conclude or suggest that the asceticism of his great progenitor had taken the same course as his own, and had led him to adopt the system of Gautama. It is very unlikely that such a dedication should have been made, and such expressions used, in regard to an obscure priest. The form of the letters, the use of the Sanscrit dative in आय, and च, for which व was afterwards substituted, all point to a comparatively early date.

XVI.

No. 16 of Mr. Brett's fac-similes.

सिधं थेरान भयत भितभतीन
लेण सागरपालोगय देय धम

*Translation.*

Peace. To the Perfect one. To the men of established principles, the saviours from fear, and who are content with moderate things, the religious assignation of a grotto by the High Admiral Ugra. Peace.

*Notes.*

The last part of the first line I would write in Sanscrit thus :—भय चमितभृतानां. Perhaps the latter epithet should be मित्रभर्तृनां, "the cherishers of their friends." The figure Svastika is here so formed, that both at the beginning and the end the upper peak should be to the letters.

## XVII.

This (No. 17 of Mr. Brett's fac-similes) is found on the upper part of a small dágoba, in a very small cave, a few paces to the right of the great cave, and may very readily be passed, unless the visitor is looking out for it, as it lies a little off the foot-path.

सिधं हेरनकस धमनकस भया अ
मव पालितन कयमय धम
थेरान भयत धम लेण
ढव

*Translation.*

To the Perfect One. The religious assignation by the goldsmith Dharmanaka of a fear-destroying religious grotto, with a dágoba, for the teachers of established principles, full of holy deeds, preserved from fear and disease.

*Notes.*

The use of न for ण in the word for goldsmith is remarkable, and we should now say it characterized an inhabitant of the northern parts of the Márathi country, or of the Gangetic provinces. In the second line we have व for च, which is the present custom in Márathi, especially in the Concan. कय as a corruption of क्रिया. In the Kalpa Sútra it is correctly किया, but this I think merely a corruption of the same word. In the third line the first letter is थ, and not ढ, as I ascertained on personally examining the inscription. ढव can only be for ढूप, the corruption of the Sanscrit स्तूप, a tumulus, and here applies to its representative the dágoba. For the last letter see Vararuchi ii. 14; and although his Rule iii. 12 gives for the first syllable थू, yet in this instance we must suppose a further corruption: in Maráthi it is टेप.

## XVIII.

This inscription has not been taken by Mr. Brett. It is No. 20 of Dr. Bird's work, and on the left hand of the rivulet. It is much broken at the beginning, and one or two lines are entirely gone.

..... .....
[..... प ] वनकस पवजितस
..... धमले [ ण ] पाणीय पोढीव
[ दे ] यधम [ चाऊ ] दिसभिखूस घहाति॰
ठापित माता पितर उद्दिस सव सतन
हित अखय असणो च निवाण सभार
य एत सच अखय निवि

*Translation.*

The religious assignation of a religious cave and water-cistern by ——— when he was purified and initiated. A house for monks from the four quarters (of the earth) is here established. Come all ye of his race from regard to (the donor's) father and mother, even to the seats for the assembly who seek spiritual emancipation. Here is truly an inexhaustible treasure.

*Notes.*

प्रवर्जित is a Jain word, that in the comment to the Kalpa Sútra is interpreted "initiated," in Gujaráthi दिक्षा लिधी. Owing to the imperfection of the inscription generally, and the obscureness of some of the letters, I doubt whether I have hit the idea in the last line but one. The only new word is निर्वाण, a term very common for the final state of bliss among the Jains and Buddhists—among the former, and also among the Nepaul Buddhists, meaning a state of supreme knowledge and bliss, probably with separate consciousness; among the latter, or Buddhists proper, cessation from desire, and union with universal nature; for the first principle of the Buddhists, like that of Kapila and Thales, is "an intellect-imbued-matter."

There are still a few more broken inscriptions, fac-similes of which will be found in Dr. Bird's work. They are Nos. 15, 17, 19, 22, 23, 25, 26 of his Inscriptions from the Kenery Caves. None of these have been taken by Mr. Brett. On examining them with some degree of care, I find such words as लेण, भिख, अखय निवी, चिवरिक, कहापण, and so on, occurring in them, proving that their general import is the same with those already translated. No new proper names have been detected, or any fact elicited, beside those already placed before the

reader; and therefore any attempt at their restoration would, though successful, be productive of no advantage. These broken inscriptions, notwithstanding, may help to a classification of the different caves, when a plan of them all is executed. The first in the list, however, being in the character of the 7th or 8th century, and much posterior to any of the rest, may admit of explanation, when the Adjunta inscriptions have been examined, which are in the same style. I have written to Dr. Bird to have an exact impression taken for me from the copper-plate found in the tope, which, if it arrive before the publication of this paper, I shall also translate, and add as an Appendix.

## APPENDIX.

Not having succeeded in obtaining, up to the end of May 1853, when this paper is passing through the press, another copy of the inscription on the plate dug out of the Káṇheri (Kenery) tope by Dr. Bird, I now give as correct a transcript and translation of it as I am able from plate xlvii. No. 28 of his work on the caves. The inscription is in Sanscrit, and the greater part of it is there sufficiently correctly given for translation. But there are a few places in which, either from the fault of the copyist, or the decay of the original, the characters are so imperfect that nothing can be made of them without some conjectural changes. Happily the words of the date, (with the slight exception of द्वय, which looks like व्हय,) the name of the donor, the names of most of the objects of worship, the fact of the depositing there of a supposed tooth of Buddha, and the erecting a monument to one of his disciples, the points chiefly important in the inscription, with the exception of the name of the reigning monarch, are easily made out; though some of the imagery, and descriptive epithets, present difficulties in the decyphering of the letters as well as in the construction. I was not aware till I had finished my labours that a translation of this inscription had been given in the Jour. As. Soc. Bengal, p. 97; but after a careful comparison I did not see any reason to change anything I had written, (except in the first line to adopt उत्तरे for वर्त्तते, which I had previously given,) much less to acquiesce in the general purport of that version.

As there are several other topes at Káṇheri, would it not be worth while to open more of them, and see what antiquarian riches they contain?

[1] नमस्सर्व्वज्ञिय॥ श्रीलपकार्ण प्रवर्द्धमान राज्ये संव्वत्सरे श्रतद्वय पंचचत्वारिं
श्रदुत्तरे कण्हगिरि महाविहारे

[2] सिद्ध विजयान्ध्रभृत श्रामीकार्णक वास्तव्यस्य पुत्र्या : बुद्धश्रिया पुष्यवर्म्मना-
म्ना सुश्री दशबल बलि

[3] नो भगवत श्शाक्यमुने स्सम्यक् समबुद्धस्य तद्धर्म्म श्रावकार्य्य गन्धचये
हि परिचरेहि कुशल बुद्धरुचिरो

[4] दंतोप्येव परममुने रग्रय श्रावकस्यार्य्या शारद्वति पुत्रस्य चैत्यं घटित पाषा
णेषु कान्तिरोच

[5] नार्क्कार्ण्णवे प्रितिस्थिति सामकालिनं प्रतिष्ठापितं वास्तव्यस्य देव यक्ष सिद्ध
विद्याधर गन्धर्वा ऽ हि भद्रा पू

[6] र्ण्णा भद्रपद्मी काव्य वज्रपाणि वाड्कानीनादय : स्वर्गे दिव्यन्त्यपिच या
वद्दिवि सहस्र प्रचलति मकरा

[7] घूर्णोतावत्तिको ऽ यं क्षीरोद : क्षीरगौ यो बुद्धो प्रफुल्लचित्र मुनीशो वा
पिमेरु : यावद्वियान्ति नद्य

[8] स्तु विमल सलिलस्य सरान्तोयवत्य : तावत्कीर्तिस्तीरयतु जन्य शुभका
रीसत्सत्रं पुष्पनाम्ना

[9] दाढा

*Translation.*

Adoration to the Ever Blessed. During the reign of the fortunate Kripa Kárṇa, on the completion of the year two hundred and forty-five, there was in the great monastery in the Kaṇha hill (a son), favoured by Buddha, and named Pushyavarman, of a daughter of a kinsman of the exalted S'rámí Kárṇa, of the victorious A'ndhrabhrita family. He in a heap of spicery, in a manner due to a noble layman of the religion of the all-blessed powerful hero, the possessor of tenfold might, the lord, the S'ákya sage, the true and perfect Buddha, and also in the midst of a multitude of attendants, while forming at the same time a receptacle for the prospering delightsome tooth of Buddha, established a sacred monum ent for the sage's chief lay disciple, the son of the lady S'áradvati, in the midst of polished stones, a very crystal sea of light and radiance, at a time indicating love, stability, and conciliation.

While Deva, Yaksha, Siddha, Vidyádhara, Gandharva, Ahi, Bhadrá Púrṇá, Bhadra Padmí, Kávya, Vajrapáṇi, Vách, Kánína, and others venerated by this kinsman, enjoy themselves in paradise, during the thousand revolutions in heaven of the Celestial Dolphin, so long shall this sea of milk, this cow that yields whatever is desired, Buddha, the joyous, the wonderful, the chief of sages, the pole (round which the world revolves), endure. And as long as the liquid streams give birth to the pure water cascades, so long may fame carry down the renown of the benevolent, holy benefactor, born for the benefit of others, and rightly named Pushya (the Protector).

## THE TUSK.

### *Notes.*

The reigning monarch at the date of this inscription we have seen reason to believe was the great Sát Karṇi. The surname in our text is equivalent to Karṇi; and perhaps कष, like the श्यान्त of the Bhágavat, is no more than a translation of the less common word श्यान; yet the reading is doubtful, and the letters as they stand would give कूड or कूट. Among the less common names here given to objects of worship, *Áhi* may mean any of the serpent race, Vásuki, Ananta, &c., or a serpent generally. I read first आली, *a female friend,* and applied this term to the Apsaras—hence an error has crept into the 8th page of the foregoing paper on the Káṇheri caves; the Devanágari was amended, and the translation left as it stood at first: this, then, requires to be corrected. *Vách* is Sarasvati; *Kánina* is most likely Vyása; *Bhadrá Púrṇá* is Annapúrṇá. In reference to *Bhadra Padmí* it may perhaps be two names, and mean S'iva and Vishnu; but the reading is doubtful; and if the last word should be read *Pakshí,* as I now incline to read it, then Garuda will be intended. By *Makara* I would rather understand the heavenly S'is'umára than Capricorn, unless this was the first of the constellations at that period, or the one under which the ceremony here here mentioned was performed. (See Vishnu Purana, Book ii. c. ix. and Prinsep's Useful Tables, part ii. p. 18.) For वयान्ति of the original, I have substituted वियान्ति, and have translated as if it were वियन्ति from वी, though, perhaps, a suitable sense might be derived from या with वि prefixed. नीरयतु, in the sense of "carry over," used figuratively, which is in the text, is doubtful. प्रीणयतु, "love, cherish," &c. would be fully nearer the original letters, but the general sense is not materially different. To other minor difficulties I do not feel it necessary particularly to refer.

ART. II.—*On the Násik Cave-Inscriptions.* By the Rev. J. STEVENSON, D.D.

Presented 17th February 1853.

## OBSERVATIONS ON THE DATES FOUND IN THE CAVE INSCRIPTIONS AT NASIK.

THE difficulties connected with Indian Chronology, it has long been seen, can only be solved by the aid of inscriptions, as the written notices are either too vague or too theoretical to gain the confidence of the inquirer after truth. It was in the hope of throwing some additional light on this, as well as on other subjects, that I lately laid before the Society some observations on the historical names contained in the Káṇheri (Kenery) Inscriptions. I was not successful in discovering there any date, although the inscription on the copper-plate dug up out of the tope in 1839 with a date of Samvat 245, corresponding to A. D. 189, in which mention is made of caves being there at that period, throws light on the subject. The inscriptions on the caves at Násik, which I am at present engaged in translating, I find contain five dates. The first, which is in Inscription No. 1, is given at the beginning in words and figures, and at the end again only in figures. In No. 2 there are two dates, but both only in figures. In No. 12 there is one, which is given only in words, and there is one in No. 7. In looking, for the sake of comparison, at the Kárlen inscriptions, I find dates in Nos. 3 and 18, both of them in words and figures, and these the same dates, almost, as in our Nos. 12 and 2 respectively. The figures in all of these are of the same character as those given by Mr. Prinsep in vol. vii. of the Journal of the Asiatic Society of Bengal, plate xx., though not all quite the same. Owing to the smallness of the numbers, I was at first of opinion that these dates had reference merely to the years of the reign of the particular sovereign celebrated in the inscription, and hence of little value ; and this is, indeed, the case in reference to the date in No. 12, and the corresponding date of No. 3 at Kárlen, and that also in No. 7. But when I found, on particularly

examining No. 1, that the sovereign Gotamiputra, there extolled as king of kings, and reigning from the Himalayas to Ceylon, and whose queen caused the cave on which the inscription is engraved to be excavated, was a different person from the one whose name is mentioned in the date, I saw my original idea to be wholly untenable. Gotamiputra, whose name is so often mentioned in the inscriptions, was one of the A'ndhra sovereigns; but no name in the least like Pudumáyi, or Pudumáva, son of Vásava or Vásiva, from whose years the inscription is dated, is contained in any of the lists of that dynasty. The important question then arose, what is the era here referred to? In casting about for information on this subject, I found that the son of the supposed institutor of the Balabhi era was named Padma A'ditya. It then occurred that the era in question must be the Balabhi. Colonel Tod ascertained from an inscription discovered by him in the great temple at Patan Somnáth, in which a date is given in the Balabhi, as well as in the common Samvat and Hejira eras, that the era in question commences A. D. 319.* Assuming, then, this to be the era of our inscription, the 19th year,—that contained in inscription No. 1 will fall in A. D. 337. Calculating by the detailed years given in the Matsya Purána from the beginning of the A'ndhra dynasty to the first year of Gotamiputra, we find the sum of the reigns to be 340 years.† Subtracting 18 years for the time the dynasty ruled before our era, we obtain A. D. 323 for the beginning of this sovereign's reign. He reigned in all twenty-one years, which will give us A. D. 343 for the last year of his reign, but as the items of these reigns fall short by twenty years of the sum total, we must suppose that the number of the years in some of the reigns has been curtailed, and thus though there were a difference of a few years between the Purans and the inscription, it would be easily accounted for; and though with Prinsep we date the rise of the A'ndhra dynasty B. C. 22, we shall still not exceed the limits of Gotamiputra's reign. Another of the dates, that of No. 2 of the Násik inscriptions, is twenty-four, giving us A. D. 342. No. 18 of Kárle*n* is the same; Gotamiputra is not, indeed, distinctly mentioned as reigning, but this is to be inferred, and the era is the same as that of the former inscription: we are still, then, within the limits of the Puranic chronology. The second date in No. 2 is only given in figures, but I suppose the years to be 24, from the resemblance the figures bear to the other numerals which have that value.

* Tod's Rajasthan, vol. i. p. 801.

† See Wilson's Vishnu Purána, pp. 473, 474, note 63.

The year, then, of the latter date, will be the same as that of the former, and only the months and days different.

In all of these dates the season of the year, the fortnight, and the day only are given; so that at that time the Hindus in this part of India did not reckon by months. There were six seasons, each of them containing six fortnights, and each fortnight fifteen days; but in the Satrap inscriptions, which were probably engraved before that period, months are used, as at present. Although the Prácrit words Pudumáyi and Pudumáva, which are used in the original, are not very remote from Pauma the Prácrit, and Padma the Sanscrit words, yet there is some difficulty in making out Vásava. Vasudeva and Vásudeva are names very common among the Hindu kings, and are both famous names in connection with the legends of Krishna. Vásava, too, is a name of Indra, and Vasu a name of the sun; and it is probable, that from reference to one or other of these deities, the name was bestowed on the monarch in question. The name Vijaya, which he bears in Tod's Annals, is evidently merely an epithet, meaning "The Conqueror." His proper name probably was S'rídhara, as found in the copper-plate inscriptions.

But what is especially to be noted is, that in the Ayín Akbarí, a prince named there Sadrau-senah, no doubt the S'rídhara Sena of Wathen's copper-plates, is said to have reigned at Oujein, and to have succeeded to the throne in A. D. 201. The father of this prince is called by Ferishta Básdeo (Vásudeva), the very name we are in quest of, though removed one generation further back. Ferishta makes him reign at Canouj; Wilford, however, from a Hindu work named the Vikrama Upákhyána, concludes that he reigned in Gujarát, and that his patrimonial possessions were those of Balhára, or Balabhi. The kings of that race are still remembered in Gujarát as the Gardabha sovereigns, and their money called the *Gadhia Paisa*, or asses' pence.* Little as we might be disposed to trust to any one of these traditions, their concurrence seems only explicable on the supposition of truth lying at the bottom of them. Vásava, too, as a patronymic derived from Vasu, is equivalent to A'ditya.

To account for the name of a Gujarát sovereign appearing on works executed in the Deccan, we may suppose that the Balabhi kings were at first only, as their names indicate, the generals of the deputies or Satraps of the Parthian monarchs, whose sway extended over a great part of Western India, and who are mentioned as having humbled the

* As. Res. Cal. edn. vol. ix. pp. 149 and 153. I have not, however, been able to obtain a copy of the work mentioned in the text.

A'ndhra or Sát Karṇi kings, in the Girnár inscription decyphered by Mr. Prinsep ;* that by the help of the Sát Karṇi monarchs, about the time in question, they rendered themselves independent; and that their alliance with the A'ndhra kings was cemented by marriage, the queen of Gotamiputra, who caused the cave to be excavated, being probably a daughter or sister of the Balabhi monarch who established the new era. The probability of this supposition is increased from the writer of the inscription's postscript, in which he states that he wrote the record of Gotamiputra's prowess and glory at the command of Padma, the son of Vásava, the Gujarát king. Thus, also, the overthrow of the Indo-Parthian kingdom will fall to be dated at the commencement of the Balabhi era, established in memory of that event, in A. D. 319 ; the nominal sovereignty, at least, having been maintained in India three quarters of a century after its extinction in Persia.

The numerals in which the dates in these inscriptions are written are worthy of notice. The years are given according to a system of notation not very different from the ancient numerals explained by Mr. Prinsep in plate xx. vol. vii. of the Jl. As. Soc. of Bengal. In reference to the demi-lunations or fortnights, and days, a method is followed which in the main corresponds with that employed in Western India, and all over the country, as far as I know, for fractions of money and weights, as will be seen from the appended table. In the Satrap inscriptions, however, the numerals used to express the different sums of money there mentioned are peculiar. At first I could determine nothing about their origin, but on a more careful examination I found a striking resemblance between the character denoting a thousand (Sahasra) and the Bactrian S reversed. This induced me to examine the rest of them, and I think it exceedingly probable that they are all derived from that source. The Bactrian *Tz*, pronounced in Sanscrit *J* or *Dsch*, will represent well the figure, which is first in 15 or 10 *(Dasha)*. The sign for 5 *(Pancha)* is the *P*, or the old Indian प inverted. The Bactrian double *T* also approaches very nearly to the 8 of our inscriptions, as if to denote अट. It would appear, then, that the Bactrian letters had been introduced into the Satrap Indian inscriptions as numerical cyphers. The system, also, is the ancient Roman and Greek one—that in which there are different signs for the 1 in tens, hundreds and thousands ; our present decimal notation being, as I have noticed elsewhere, a comparatively modern invention of the Scindian merchants of the middle ages. (See Jl. Royal As. Soc. Bombay,

* Jl. As. Soc. of Bengal, vol. vii. p. 341.

vol. iv.) Future research will probably show, as Mr. Prinsep has done with a few of them already, that the old Indian numerals are also ancient letters.

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## Observations on the Nasik Inscriptions, with Translations.

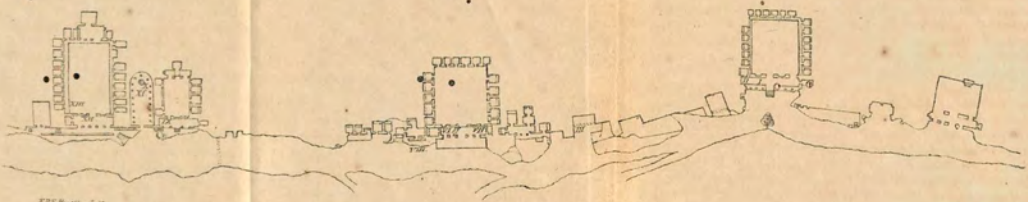
[Presented 17th March 1853.]

There are three principal caves at Násik, each of them containing inscriptions of considerable historical importance. The other smaller excavations and their inscriptions are of less interest, although they supply one or two facts. The first of those caves—that most to the left—was excavated by order of the queen of Gotamiputra, the celebrated A'ndhra monarch, mentioned before in connection with the Káṇheri (Kenery) inscriptions. We have in Inscription No. 1 first an eulogium on this king, and next one on his queen. In the former the extent of his empire is described, in which several of the Eastern and Western provinces are specified; while the Pariyátra, the Sahyádri, the Malaya, the Mahendra, and Himálaya mountains, are said to bound his empire. At the same time he is said to have reduced to subjection the sovereign of Ceylon, and driven back the Scythians, Greeks, and Persians; probably in aid especially of the Balabhi sovereign who established the independence of Western India by shaking off the yoke of foreign domination. At his capital city, which, however, is not named, four great institutions are said to have been supported by him—one, a hospital for the sick and infirm, a second a school for archery, a third an institution for Buddhist learning, and the fourth a Brahmanical college; presenting us with a most interesting picture of a humane, enlightened, and liberal government. This is the inscription, as before mentioned, that is dated from the Balabhi era, and particularly interesting, also, on that account. The second inscription is a deed of sale by the original proprietor to Gotamiputra's agent, in which he makes over to him in perpetuity, in a legal style that would not disgrace Westminster Hall, all his right in the field in which the cave is excavated, for the consideration of three hundred rupees. This document is valuable, as demonstrating the just principles of government in regard to private property acted on by those monarchs; and shows that the English were not the first who, in India, compensated individuals whose property was required for State purposes.

The inscriptions marked 4, 5, 6, 7 are inscribed on the central cave of the group, and show it to have been excavated by the son-in-law of

one of the Kshatrapas or Satraps of the Parthian monarchs, who, about the commencement of the Christian era, reigned over Western India. The Kshatrapa's name is Nahapána, and the sovereign's Kshaharáta. Neither of these names is Indian. The latter, however, is not unlike Phrahates, and may not improbably be intended for the fourth Parthian monarch of that name, who reigned about the year B. C. 22. The son-in-law named Ushavadáta, son of Dinaka, was evidently from these names a Hindu, and was the general who fought his battles for him—a fact worthy of notice, in connection with the rise of the Balabhi monarchs. His wife, too, named Dakshamitrá, had no doubt an Indian mother, who might not improbably be connected with the royal Sunga family, shortly before that time reigning in Magadha, and whose surname was Mitra. It might, perhaps, be deduced from the Inscription No. IV., that Ushavadáta succeeded his father-in-law; for after mentioning an expedition of his into Malabar to aid the Kshatriya (Nair) rulers, against the rebellious natives of the province, he is said to have had the ceremony of Abhis'éka performed at Pushkur (Pokhur); yet the ceremony in question might mean no more than a kind of special thanksgiving for victory. In No. IV., from whence these historical facts are deduced, he is said to have been most liberal in his largesses to Brahmans, at Prabhás, and others of their holy places; while, from the other inscriptions, he appears to have been even more profuse in his donations to the Buddhist priesthood. The large sum of a million of gold mohurs, equal to a million and a half of English money, is said to have been devoted to their support. These are the inscriptions that contain the curious numerals, derived, as I apprehend, from Bactrian letters, as before mentioned. No. IV. also acquaints us with the important fact that Malabar was a dependency of the Indo-Parthian Empire; and thus probably the *Huna* coin was introduced into the peninsula. The farthest distant cave of the whole group, that most to the right, was excavated by order of the wife of the Commander in Chief of Yadnya S'ri, the descendant of Gotamiputra, who, in 428 of our era, sent an embassy to China. As this cave was made in the seventh year of his reign, it may probably have been excavated in A. D. 433, or fourteen hundred and twenty years ago. It is, however, to be recollected, that there is a discrepancy of 42 years between this chronology, founded on the records of China, and that derived from Puranic calculations (page 36), which would give A. D. 391.

The other caves have on them the names of provincial chiefs (Ráya) or ascetics, of whom we only learn that the excavations in question were executed by them for Buddhist priests.



F.P.F. Brett. del.

*The Numbers from one to thirteen shew the situation of the Inscriptions which I have numbered in the same manner.*

F.P.F. Brett.

Scale

PLAN

of the

CAVE-TEMPLES

at

NASSICK.

On the whole, we find that Brâhmans and Buddhists, in these early years of our era, lived in peace with one another, and were both favored and protected by the reigning sovereigns; and that among the former the Sanscrit language was used in writing, and the Prâcrit by the latter; the two languages, probably, holding the same place to one another that the Sanscrit and vernaculars do at present. The Prâcrit, also, had different dialects; and Inscriptions Nos. V. and VI. contain substantially the same thing, repeated in different words, being probably written, one of them in the language of Gujarât, and the other in that of the Deccan, dialects which seem even then to have differed, as they do now, though in a less degree. No. II. also repeats its story in different words, probably for the same reason.

[N. B.—Letters supposed to be obliterated are enclosed thus [ ]; those substituted for letters supposed erroneous thus ( ).]

## Inscription No. I. in Devanagari.

[1] सव [ ज्ञस ? ] राज्ञो वासिवापुतस सरो पुउमायीस समरे एकूनेवीस १९ गिम्हान पखे बितीये २ दिवेसे तेरसे १३ राजराज्ञो गोतम पुतस हिमविति मेरु

[2] मद्दर पवत समसरस असक असक मुडके सुरठ कुकुरापरत अनुप विदभ आकरावतिराजस विप्रक्वत पारिचात सह्य कण्हगिरि मच सिरीठन मलय महिद

[3] सेट गिरि चकोर (क ?) पवत पतिस वराज लकमडलपति गहित सास नस दिवसकर वर विबोधित र (क ?) मल विमलस दिस वदनस ति समुद तयपित वाहनस पडिपूण चदमदलस सिरीक

[4] पियदसनस वर वारण विकम चारु विकमस भूजगपति भोगपीनवट विपुल दिघ सुद [ स ? ] भुजस अभयोदक दान कीलिन निभयकरस अविपनमातु सुसुसारस सुविभत तिवग देस कालस

[5] बेर (रि ?) जननी विसेस समसुख दुखस खतिय दपमाने मदनेस सक यवन पल्हवनी सूदनस धमोपजित करविनियोग करस कितापराधे ऽपि सतुजने अपाणहिसारुचिस दिजावर क (कु ?) टुब विवध

[6] नस खगरातवेस नीरविसेसेकरस सत वाहन कुलयस पतिठापनकरस सवमंडला भिवा (वं ?) दित च [ र ? ] णस विनिवतित चातुवणस करस अनेकसे (स ?) मरा वजित सतु सघस अपराजित विजयप ताक सतजन दुपधसनीय

[7] पुर वरस कुलपुरिस परपरागत विपुल राज सदस आगमान [ य ? ] लयस सपुरिसान असयस सिरीय अधिठानस उपचारान पभवस एक कुसस एर (क ?) धनुधरस एक सूरस एक बम्हणस राम

[8] केसवे जुन भीमसेन तुलपरकमस कणयगसवसमाजकारकस णभाग नहुस जनमेजय सकर (कारि ?) ययाति रामाबरिस समतेजस अपरिमित

मखयम चितम भुत पचनग र ( ग ? ) द सिध यख रखस विजाध र भूत गधव चारण

[ 9 ] चद दिवाकर नखत गह विचिण समरति गुपि जितरिपुसघस नाग वरद धुगगन तलमभिविगादस कुल विपुले सिरिकरस सिरि सात कणिस मातुय महादेवीय गोतमिय वलसिरीय सचवचन दान खमा हिसा निरताय तपदामनीय

[ 10 ] पापवसत पराय राजरिसि वचुस उमखेल मनुविमयमानय कारित देयधम.....सिखरस दिसेवि ( ति ? ) र ( क ? ) णह पवत सिठाय विमल वरनिविसेस महिपीक लेण एत च लेण महादेवी महाराज मातु महाराजपतामही ददाति निकायस भदा वणियिन भिखु सघस

[ 11 ] एतस च लेण पविनण निमतो महदेवीय अयकाय सेवक मो पियका मो चण...पठेसिरो हिणिपतियेदु धस सेतुस रदा [विराजि ?] त गोमतर (क ? )णह पवतस अपर दखणपसपि समपादुक सवजात चानिरुध न

*Translation.*

To the Omniscient. In the nineteenth year (19) of the second month (2) of Summer, on the thirteenth day (13) of the fortunate Padma, son of king Vásava, (this religious assignation was made by the queen) of the king of kings Gotamiputra, whose sway as universal lord extends beyond the Himálayas to the Meru and Mandara mountains; and who possesses the large revenue-producing realm, with its united provinces of Mundaka, S'auráshtra, Kukura, Aparata, Anupa, Vidharbha; who is lord of all the circle of mountains, of the Vindhya and Pariyátra, the Sahya and Kanha hills, Mancha and S'rístana, the Malaya, Mahendra, and S'reshtagiri mountains. To whose commands Varája, lord of the circle of Lanka (Ceylon) submits; who is venerated in the region of pure lotuses, where Súrya went at the suggestion of Chháya (Uttara Kuru), whose prosperity and beauty are admired within all the circle of the three seas, filled with the three liquids, and even within the whole lunar orbit, uniting beauty and heroism, showing himself a hero both in taking up and defending his position; possessing arms like the body of the serpent monarch, muscular and round, large, long, and beautiful; who delivers his captives from fear by pouring on their hands the water that betokens security; whose mother is spotless, and sister irreproachable; highly favoured in respect of the three objects of human pursuit, and of country and time; having his forehead adorned with saffron and the imperial pigment; who maintains his equanimity in pleasure and pain; a Kshatriya, flaming like the god of love, subduing S'aka (Scythians), Yavana (Greeks), and Pahlavani (Persians); spending in charity the revenue he had justly acquired; inclined to spare the lives of good men,

even when they have committed a crime; promoting the increase of the families of high and low; who could prognosticate from birds, from the aspect of the heavens at night, and from dress and water; who has established houses for charitable refreshment, and stabling for cattle; at whose feet the nobles from all the provinces come to bow down, and before whom the four mixed castes prostrate themselves; who is surrounded by a priesthood, with minds subdued by self-denying rites; whose unsubdued victorious ensign, blessed and consecrated by solemn ceremonies, is held up by a virtuous standard bearer; who has a numerous royal council of men of noble birth, virtuous, and of ripe intellect; who adheres to law and equity, and is the asylum of good men; who has established in the fortunate capital (four) institutes, one for the sick and infirm, one for archers, one for Buddhistical learning, and one for Bráhmanical literature; whose might is equal to that of Ráma, Kesáva, Arjuna, or Bhimasena; who celebrates festivals, performs sacrifices, offers oblations, and makes feasts; possessed of a glory equal to that of Nabhága, Nahusha, Janmejaya, Vikramáditya, Yayáti, or Balaráma; whose fame resounds from pole to pole, and whose praise is celebrated by the unbounded, indestructible, incomprehensible, astonishing, five-clawed (Garuda), the Rudras, Siddhas, Yakshas, Rakshashas, Vidhyádharas, Bhútas, Gandharvas, and Chárans, along with the equanimous, appetite-restraining, passion-subduing company (of Rishis), who inhabit the moon, sun, stars, and planets; who is of the numerous fortunate family of S'rí S'áta Karṇi. It was Umákhelá, his chief queen, and matron of the family, allied to Gotama and Bala S'rí; embued with truth, bounty, mercy, and patience; remarkable for her austerities; who had overcome sin and disease, and was worthy of a reverence equal to that of the wife of Manu, that caused this religious assignation to be made..... (Come) in the direction of the illustrious peak of the Kaṇha hills, to the queen's grotto, clean, and beautifully gilded. This cave her majesty the queen, and the mother of his majesty, and the grandmother of his majesty, give to those worthy of praise and veneration—the mendicant priesthood. Here there is also for the holy men who inhabit the cave a pleasing, amiable band of attendants, supported byher venerable majesty the queen..... On this cow-pasturing Kaṇha mountain, forming a religious bridge for the moon, the husband of Rohini, and (illustrated by the Buddha)-tooth, situated in the South-west region, is a cave having the impression of (Buddha's) feet, placed parallel to each other, and open to all classes.

*Notes.*

I have inserted in parentheses, formed thus ( ), several letters, in

substitution of those in the preceding inscription which I suppose erroneous, when the error was of importance enough to require notice.

After the chronology, which has been already discussed, the most important thing in this inscription is the geography; and in this Wilson's Vishnu Purána will furnish all the light that can be thrown upon the subject, for words not found in the dictionary. The first province, Muṇḍaka, probably designates Bengal. It occurs as Maṇḍaka in the Rámáyana among the Eastern nations. (Vishnu Purána, p. 193, n. 132.) Saurarâshtra probably included all the Southern parts, if not the whole, of Gujarát; and Kukura is the territory of the Yádavas, that is, either the country about Mathura, in the North-west, or the Peninsula, since authorities differ on this point. The word occurs twice in the Mahabhárat list, and thus was most likely applied to both districts. (Vishnu Purána, pp. 187, 193.) Aparata was probably the country of the Aparytae mentioned by Herodotus, lying somewhere on the banks of the Indus (Vishnu Purána, p. 189, n. 60.) The Anupavritas are mentioned in the Mahabhárat next to the Marubhaumas; and from the connection with Vidarbha (Berar and Khándesh), it likely refers to the countries on the Nerbudda. It is evident, then, that only distant provinces, most of which were probably ruled by dependant kings, are here mentioned; the central Magadha is supposed to be too well known to require notice.

It may be observed that there is no king mentioned in the Mahavanso with whom the sovereign of Ceylon here noticed can be identified. There is, however, an ancient name, Vara, of Ceylon, among the Buddhists, from which it may have been derived, and applied as a general term to Ceylonese sovereigns. (Mahavanso, vol. i. p. 91.) The first mountain called Viprachhavata must be the Vindhya, and the name allude to the passage of Agasti. The next mountain, Paricháta, must also be the Pâryátra, or Western portion of the Vindhya chain. The Sahya is the Western Ghauts to the South of Bombay; and the Kaṇha would seem to be the hills about Násik and Kenery in the Western Ghauts and the spurs that branch out from them to the North of Bombay. The first place where the legends about Parshurám commence to affect the names of places is at Parshurám Kshetra, to the South of Bombay, ninety or a hundred miles, near Chiploon. A hill on the Ghauts close by is mentioned as the place whence he ordered back the ocean, and made the Concan habitable. Similar legends are repeated further to the South, and applied to other localities, but none to the North of us; and it is from him that the term Sahyádri is derived. The Malaya mountains in Malabar, and the Mahendra in

Cuttack, are too plainly designated to require any notice here. The S'reshtagiri, too, is probably Kailas, a hill in the Himálayas, but the Mancha and S'ristana are not so easily identified. Perhaps the words should be joined together, and the compound word applied to the Nilgiris, the only important hill that comes between the Sahya and Malaya mountains. The general order in which the mountains are named almost forces us to this conclusion. Mancha means a table, and S'ristana the breast of the goddess of prosperity ; and any one who has looked at that detached mass of mountains with its peaks at a distance, and ascended to its extensive table-lands, will hardly consider the name when applied to the Nilgiris far-fetched for a Hindú. In some of the other inscriptions, however, the Mancha as well as the Kaṇha hills are identified with the Ghauts that contain the excavations and inscriptions ; and this may be the case here also. The three seas here are probably the seas of salt water, fresh water, and the frozen ocean, metamorphosed by the Hindús into the Sea of Milk. These are the only ones which can lay any claim to antiquity ; the other four are inventions of the prurient imaginations of the modern Puránic writers. The ancient Jains, when the Kalpa Sútra was written, B. C. 411, three quarters of a century after this inscription was engraved, had only two seas, that of salt and that of fresh water, and three continents. The castes at the period in question seem to have been but eight, four pure and four mixed. Those who have not been in India may require to be informed that the most insufferable kind of abuse among the natives is that of a man's mother or sister. Among the deities mentioned in this inscription, the ancient Vedic gods appear, and the sages who inhabit the sun, moon, and stars ; but there is no trace of anything like Mithraic worship. All here named agree entirely with what was previously observed on this subject. The term Govardhan is in this inscription, as in others, applied to the hill whence the caves are excavated, but I have translated it here as an appellative. The last line to me is rather obscure, and I am not quite sure that I have hit the idea. Yet I think it not unlikely that most of the distinguished Buddhist places of pilgrimage boasted of a tooth or other relic. The construction of the greater part of this inscription is not difficult, and I must leave it to the judgment of others to determine how far I have given the meaning. The length of these inscriptions would make an analysis like what I gave in the case of the Kenery ones tedious, and perhaps uninteresting to all for whom it can be necessary.

A supplementary inscription in a smaller character, with the lines a

good deal broken, follows. Of this Mr. Brett has taken a copy, but not a fac-simile. I can only make out enough of it to see that it is an explanation of the above, or such a supplement to it as is common in the Násik inscriptions. It has the same date, but the date is given only in numerals. A river named अईरक is mentioned in it, probably as one of the boundaries of the field mentioned in next inscription, and the name of the rivulet that runs past the caves towards Násik. It is specially to be noticed, however, that the writer names Padma, in whose 19th year the inscription is dated, as the sovereign by whose command he acted. His words are नघकरमम वसिविपुतो सिरिपुदुमावि अनपयंति. This shows clearly that there must have been some family connection between the Gujarát king and the Indian monarch, or he would not have permitted the name of a foreign sovereign to figure in the way it does in this inscription.

No. II.

[1] सटा ..... तायवजवय ..... ...गोवधनस पनकटक मम गोतम पु
ते सिर सद्कने

[2] अननतयेत गोवधने अमच वतपालितामे कपर कखद्य खेत अ
ज कालरिप उसभद्तेन भत निवचर (ण ?)

[3] सतानि ३०० एते अम्ह खेत · · वतन प (स ?) तान ३०० द्मेसे पव
जितन तरिरसन वितरम एतसचस खेत सपरिवरो

[4] वितराम अपमस अखामस अलो · · पारादिर (क) अरठास विनय
क सवजत परिहारिर (क ?) व एत हीन परिहारेहि परिपे [णे] हि

[5] एतसचस योत हारिपरेच एध निबधलप अवसने अनत अमविन
सेव हेतीन कतो मह्समिच हि उपरे खितो

[6] द्ता उतिरा सवकरे २४ · · वसण ..... द्विवसि .....तापसन रठ
सिद्ध गोवधने अमचस सामकस देया राजनिता

[7] राज्ञ गोतम पुतस सवकणस म [न] द्मियच जीव अतोप रजमतुय
वचनेन गोवधने ... चसमका अरोगचतव चवठवच

[8] वच एथ अमपि पततेति ...म्ह अम्ह धमद्राने लेण पताव सतान पवजि
तान भिखून गमे रखद्मु पुवखेत द्त तचेखेग (त)

[9] वेकसभस च गमो नवसति एधसति यजारि एथ नगर सोम रजर (क)
खेते अम्ह सतक भते एतेस पवचितन भिखुन ते रणु ननद्चपि

[10] खेत सनिव तण सत ३०० वसच खेतस परिहार वितरम अववेस अने
मस अन्यन खाद्के अरठस विनेथिक सवजात परिहारिकद (च)

[11] एतोहिन परि अहिप [रे] हेर..एतवस खेते परिहारोच एथ निबधा
पठ अवियेन अणत परिहार खिय लटाय मतो लेखापी वेकरे २४

[12] उसान पखे ४ द्विवसें पचमे ५ पजितिना रेटा खेवना निवपा सवक
रे २४ गिम्हने पखे ६ (?) द्विवसे १०

*Translation.*

— I, the proprietor of Govardhan, at the command of Gotamiputra Sri S'át Karṇi, have made over this field on the elevated Govardhan, which is mine by law, and secured to me by sacred rites, and is covered with wild fig trees, creeping plants, and other herbs, to Rishavadatta, who desired to possess it, having paid me the purchase money, three hundred, 300 (rupees). I have made over this my field for three hundred, 300 (rupees), for those who, having abandoned the world, have crossed the ocean of its fascinations. I have given up this field with all its appurtenances, without any subterfuge, in perpetuity, without any cutting off or remnant, not liable to seizure by Government, by no class of men, to have any claim made on it; free from all such drawbacks in seizure and sale; also all that is connected with it in possession; and the agreement concerning it is for perpetuity, without guile, and with due consideration, cut out by a sharp instrument on the house for the religious assemblage. Given in the modern era 24, during the ... demi-lunation, the ... day, by Rashtra, the ascetic. Peace. To the Perfect One. The assignation deed of the high land belonging to the Buddhist ascetic on Govardhan, and the health-giving asylum for Buddhist ascetics, and the glorious refectory established on Govardhan, at the command of the mind-subduing, satisfied with life, royal mother of king Gotamiputra S'át Karṇi, who observes the laws of the State. Here in this uncultivated tract of mine is our religious assignation of a cave for the mendicant priests, who abide in this place, after having abandoned the world. It is the Eastern field, in the Northern part of the village, that is given, and this field is intended as a residence for the assemblies which meet for discussion, and also for silent ascetics. Here also is a house for divine worship. Here, too, close by the city limits, at the washerman's field, is our charitable institution for the mendicant priests, who have abandoned the world, and for those of established virtue. The purchase money of the field was three hundred, 300 (rupees); and this field I give over in full possession, without any deceit, for ever. No part of its produce to be consumed by any other, nor to be taken away for Government purposes, and with it no class of men may interfere. Without any such drawbacks, I give over the field in possession and seizure. And this agreement in reference to it, for perpetuity and to prevent deceit, as an everlasting deed, has been written by me Rashtra, in the year 24, in the 4th demi-lunation of spring, on the fifth (5th) day. The excellent venerable lady's prosperity-bringing rites for the

departed spirit were performed in the 24th year, in the 6th (?) demi-lunation of the winter season, the 10th day.

*Notes.*

This inscription is evidently divided into two parts, the one of which is little more than a repetition of the other in a different dialect of Prácrit, but both contain several uncommon words, such as अमच, *quasi* आमंच, at the meaning of which I have guessed through the Sanscrit roots from which I suppose them derived. Independently of these words, however, the general meaning is easily educed, and the sense cannot materially differ from what is here given.

The first part of the first line, in which the invocation might be expected, is so broken, that I cannot make it out satisfactorily. The corruptions of S'át Karṇi, the first in the last word of that line, and the other in the third word of the seventh line, teach us what we are to expect in reference to other words. The learned reader will see from the translation what Sanscrit words are supposed to be corrupted in this document. Rishaba-datta I suppose to have been the imperial agent for this affair. After the three hundred I have supplied rupees, as most probably understood: if any other coin had been meant, it would most likely have been expressed; and the sum now mentioned would have purchased a good piece of ground in that barren locality. If I am right in the explanation of the concluding sentence, which has nothing corresponding to it in the first part, it must have been added at the death of the Empress dowager.

## No. III.

This inscription is found on a small cave between the Empress' and Satrap's cave. It is as follows :—

[1] सिध वरतुहपतिस नेगमस लेण
[2] खये धम कुटुबिणीय वसनद सरिय देवरको दहुतु
[3] य चद्पुरे सदतव देवरको एव लेण चतु गुतु
[4] नियुत भिखु सघस चातु दिसस नियाचत

*Translation.*

Peace. To the Perfect One. The cave of Brihaspati, skilled in sacred learning. The fortunate Devarko, son-in-law of the fortunate religious lady Vasananda, of the city of Chandrapura, and Sadatava Devarako, bestowed this cave upon the four families of devoted mendicant priests, from the four quarters of the world. Peace.

*Notes.*

Chandrapura here mentioned is probably Chandore, half way between Malligam and Násik. गुतु in the Kalpa Sútra is the common word for गोत्र, and नियुत is by a common rule derivable from नियुक्त. The first word of the second line I suppose to be intended for श्रिय, an adjective from श्री. The names of the persons who caused this cave to be excavated may also be considered somewhat doubtful.

## No. IV.

The four first lines of this inscription are in Sanscrit, and the rest in Prácrit, as well as the three following inscriptions. All have relation to the largesses of a son-in-law and daughter of one of the Satrap rulers.

[ 1 ] सिद्धम् ॥ राज्ञः क्षहरात्रस्य क्षत्रपस्य नहपानस्य जामातृदीनीकपुत्रेण उषवदातेन त्रिगोशत सहस्रदेन नद्या बार्णसोया सूवर्णदानतीथ करेण देवतेभ्यो ब्राम्हणेभ्यश्च षोडश ग्रामदेन अनुवर्षं ब्राम्हण शतसा हस्री भोजापयित्रा

[ 2 ] प्रभासे पुण्यतीर्थे ब्राम्हणेभ्यः आप (र्षा) द् भार्याप्रद (दे) न भरुकछेदश षुरे गोवर्धने शोर्पारगे चतुशालावसथप्रतीश्रय प्रदेन आरामतडाग उदपानकरेण इबापारादादमणतापीकरबेणदाहनुकानावापुण्य तरकरेण एतासाच नदीना उभतो (य) तीर (रे) सत (त्र)

[ 3 ] प्रपाकरेण पींडीत कावदे गोवर्धने सुवर्णमुखे शोपारगेच रामतीर्थेच रक पर्षद्भ्यः ग्रामेनानगोले द्वात्रिशत् नान्दीगेर मूलसहस्रप्रदेन गोवर्धने त्रिरश्मिषु पर्वतेषु धर्मात्मना इदं लेणं कारितं इमाच षोढियो भटारका ज्ञप्ति याच गतोस्मि वर्षारत्र मालये..... हिरधं उतम भद्रं मोचयितुं

[ 4 ] तेच मालया प्रनादेनेव अपयाता उतम भद्रकानच क्षत्रीयान सर्वे परिग्रहा कृता ततोस्मिगतो पोक्ष (ष्क) रानि तत्र च मया अभिसेको कृतो त्रिणिच गोसहस्रानि दतानि ग्रामोच ॥

दतचनेन क्षेत्र ब्रम्हण सवाराहिपुत्रस अश्रभूति सहथकोर्णताम लेण का हापण सहस्रेहि चतुहि ४००० यस पितु सतकनगरस माय उतरा हरय दिसीय एत ममलेने वसतान चितुदिस भिखुसघस मखाहारु भविसत.

*Translation.*

To the Perfect One. Peace. Ushavadáta, son of Díníka, and son-in-law of the Satrap (Viceroy) Nahapána under king Kshaharátra, bestowed in presents a thousand times three hundred cows, established for the presenting of gold a holy place on the river Bárṇasoyá, gave sixteen villages to the gods and Bráhmans, and yearly feasted a hundred thousand Bráhmans. At the holy place Prabhása he was at the expense of the marriage of Bráhmans, according to the rite of the sages. At Bharukachha, Das'apura, Govardhan, and S'orpáraga he made square

buildings for houses of shelter ; he made gardens, tanks, and watering-places ; he placed charitable ferry-boats on the rivers Iba, Párádá, Damaṇa, Tápi, Karveṇá, Dá, and Hanuká, and places for the charitable distribution of water on both sides of these rivers. At the round Kávada, Govardhana, Suvarn'-mukha, S'orpáraga, and Rámatirtha, he gave to various companies in the village, for the assemblies of the poor, a capital of thirty-two thousand gold mohurs of Nándigera currency. It was this charitable person who, in the Govardhan of these mountains, which reflect the rays of the setting sun, caused this cave to be made, and these tanks to be excavated. At the command of his majesty I went to the disaffected province of Malaya, to deliver Hiradha, the excellent and fortunate [Governor]. The Malayans at the very sound of our trumpet took to flight. Having then recovered all the effects of the excellent fortunate Kshatríyas, I went my way, and came to Pushkara, where I performed the rite of Abhis'eka, and gave away three thousand cows and two villages.

This person, also, whose father was from the city of Sataka, and mother of the province of Uttarárha, bestowed a field on the Bráhman Ashribhúti, son of Várâhi, and gave a cave to the dejected, oppressed, and distressed, along with four thousand pieces of gold (4,000). In this my cave there shall be then a sin-removing abode for the Buddhist priesthood from the four quarters of the world.

*Notes.*

It is difficult for me at present to say whether the frequent omissions of the point for ण् and other anomalies, belong to the original, or are the faults of the fac-simile, as I have not had an opportunity of comparing the two. The rather anamolous form of भोजापपित्रा with the प inserted, I have ascertained to belong to the original, and this is probably the case with other unusual or incorrect forms. The word thousand, which frequently occurs, is probably sometimes to be taken, not literally, but figuratively for a great many. I have not been able to obtain anything satisfactory relative to the geography of several of the places mentioned in the text. The extract from the Mahabhárat in Wilson's Vishnu Puráṇa gives a number of the rivers here mentioned. Barṇasoya is probably the Varṇasa or Parṇásás, which flows from the Pariyátra mountains. Prabhás is a well-known place of pilgrimage on the coast of Gujarát near Pattan Somnáth. Bharukachha may be Bhúj, the capital of Cutch, or some town in that province. The three next names occur before in No. I. S'úrpakarṇa, Ravan's sister, gives name to Násik, and Supa, here called S'orpáraga. If we judge from the sound,

Iba will be the Beyah or Vipás'á in the Punjáb, and Párádá the Párvati in Malva. Tápi is the Tapti near Surat. Rámatirtha may either be the place so named in the kingdom of Oude, or a place of that name on the Godáveri, close by Násik. On the remaining words not noticed in No. I. I can throw no light. Nándigera seems to have been the name of a town from which the currency was named; thus we have Surat, Chandore, and Furukabad rupees, &c. I suppose it refers either to Anandapura, so called by the Jains, and afterwards by the Hindús named Valabhi, the capital of the well-known sovereignty of that name on the North side of the Gulf of Cambay, or to Nandgám, the seat of a sovereignty in the Northern Concan, in an early century of our era. (See Jl. B. B. R. A. S. p. 4—10.) The coinage in question was probably more valuable than others, as were our Sicca rupees, and was likely of what in the next inscription is called treasury gold. All this, however, is but conjecture: my inquiries have been unsuccessful in eliciting from natives any positive information on the subject. The Bhatáraka was probably his father-in-law, and the Kshatríyas the Nairs against whom the aboriginal Malabarians had revolted; thus making the Parthian empire extend to Cape Comorin. With the fifth line the Prácrit begins; the concluding part was probably written afterwards by a Buddhist, while the first part is the production of a Bráhman.

## No. V.

This inscription immediately follows the preceding, and enlarges on the donations to the Buddhist priesthood. It, and all the remaining ones on this cave, are in Prácrit.

[1] उषवदातेन सघस चातु दिसस दमलेण नियातित दतचनेन अक्षय निवि काहापण सहसरा

[2] एतेच काहापणा प्रयुत गावर्धन वाथवासु श्रेणिसु को ली (षी)क निकाये १०,००,००० पडिक शत अपर कोषो क [णि] क

[3] एतो ममलेणे वसहथान भिखुन विसिय एकस चिवरिक वारस कय सहस प्रयुत पायुन पहिके शते अतो ६ सण

[4] खावित नेगम सभाय निबधच फलकवारे चरिचेति उयनेन दत वस १ कातिक शुधे पनरस पुवाक वसे १ र

[5] पनरस १५ रत भगवता देवा ३,००,००० हुणानच कषापण सहसणि सतनि ५०,००० पचचिशक सुवण कतादिन सुवण सहसणमूल्य

### *Translation.*

[1] Ushvadáta constructed this cave for the Buddhist priesthood from the four quarters of the world, and he bestowed upon it as a permanent capital a thousand gold mohurs (kahápans).

[2] He gave also a million gold mohurs to the bands of those dwellers on Govardhan who have abandoned the world, of treasury gold, 1,000,000, worth each a hundred groats, and of the purest gold.

[3] In this my cave there is a property for the mendicant priesthood, who have abandoned the world, to be distributed among the individual Buddhist priests, the stock being a thousand millions : each on the great annual festival to receive a hundred groats, (properly 30 shillings, or one gold mohur,) and ordinarily six. (1*s.* 8*d.*)

[4] The well instructed assembly of Buddhist Bráhmans consecrated this treasure on a lucky day in the 1st year of the donor, on the bright fortnight of the month Kártik.

[5] There was also given over to Bhagaván and the gods on the 15th day of the——— in the 1st year, of gold húns three hundred and fifty thousands (350,000,) worth a hundred thousand gold mohurs.

*Notes.*

Few new words occur in this inscription. पायुन for पार्व्वण is the annual oblation to the manes of one's ancestors, observed over all the heathen world. In line 4th the meaning of उयनेन is doubtful.

Húns, probably originally introduced by the Huns, and worth about the third of a gold mohur now as they were then, are here introduced. This coin is now chiefly current to the South in the Madras districts, which would seem to show that the Indo-Scythian rule extended even to those regions, and that the expedition mentioned in No. IV. was to secure a permanent conquest. The Padika, taking the gold mohur at Rs. 15, or £1 10*s.*, will amount to $3\frac{1}{2}d.$, or $2\frac{3}{4}$ annas, $\frac{1}{2}d.$ less than a groat. It is worthy of remark that we have here the rudiments of the decimal system for small coins, a system now entirely lost among the Hindús.

No. VI.

The first two lines of this inscription relate to the Satrap's daughter, the wife of the abovementioned Commander of the Forces ; the rest to the General himself. Properly there are two inscriptions here.

(१) सिध राज्ञ क्षहरातस क्षत्रपस नहपानस दुहि
(२) तु दीनीक पुत्रस उषावदातस कुटुबिनीय दखमित्राय देय धम उवरको
(३) सिध वसे १ वेसाख मासे राज्ञ क्षहरातस क्षत्रपस नहापनस जामातरा दीनीक पुत्रेण

( ४ ) दतानि १,००० सघस चातु दिसस ये इम दिम लेणे वसातनभवसति चिवरक ६ श्रण मूलच

( ५ ) ये १०,००,००० पायुन पडिके श्रत एतेच कहापणा अपडि दात वा १,००० भोजा एत चिवरिक सहस्रानि ब २०,००० पडिके सते

( ६ ] मल कपुरा हारेच गामे चिखल पदे दतानि नादिगेरानमुले सहस्रनि अथ ८,००० एत च सर्व फलक वारे चरित्राति

*Translation.*

[ 1 and 2 ] To the Perfect One. The religious assignation of landed property by the lady Dakshamitra, wife of Ushavadáta, son of Díníka, and daughter of the Satrap Nahapána, Viceroy of King Kshaharátra.

[ 3 and 4 ] To the Perfect One. In the year 1 (?), in the month Vaisákh, there were gifted as follows by the son of Díníka, son-in-law of the Viceroy Nahapána, of King Kshaharátra, to the thousands of the priesthood who come from the four quarters of the world, this religious cave, to be a residence during the rainy and cloudy months; and to each Buddhist mendicant six groats, and on the great festival a hundred, from the capital sum of a million (1,000,000).

[ 5 and 6 ] A thousand Kahápans (gold mohurs) are here deposited, which are not to be expended; and for food, and to be expended on mendicants, two thousand, (2,000), in sums of a hundred groats; to be expended on camphor, incense, garlands, the village, and granary, eight thousand, (8,000), in value of the currency of Nándigera. The bestowal of all these was celebrated by a solemn religious ceremony, on a lucky day.

*Notes.*

The word चवरको is peculiar, and I am doubtful of its interpretation. दिमे is a strange word: if it is not a corruption of धमे, I do not know what it is. The 6th line seems to refer to expenses for worship, and other incidental items of expenditure. There are difficulties also in the numbers and general sense in line 5th. The ब is Gujaráthi even now for 2, and the figure like the ancient थ I suppose to be the cypher for the same. The sense of फलक is here peculiar, but no other suits.

No. VII.

This is nothing more than a repetition of the two first lines of the foregoing, on another part of the cave, and the reader is therefore referred thither for its contents. The last letters of the 1st and 3rd lines, however, are incorrect, as will appear by comparing this with the other inscriptions.

This is the last of the Satrap inscriptions, the letters of which agree not only remarkably with one another, but also with those of the Girnar Inscription translated by Mr. Prinsep, and those of the legends of the Satrap coins.

No. VIII.

This inscription is on one of the intermediate small caves.

वेलिदत्त-पुतस नेकमस रमणक
साकलि पकियस लेण [ दे ] य धम [ चतु ] दि
सस भिखु सघस नियातत दत व
नेन अखय निवी काहापण सेत दे
सघस खुध एतो वसवथस पवद्तस चव
.... कं द्रातवं बारद्क

*Translation.*

The religious assignation of a cave by Ramanáka, bearer of the royal standard, son of Velidata, skilled in sacred learning. It has been made over by him to the mendicant priesthood, and he has also added to the inexhaustible capital stock, and given a hundred gold mohurs to supply the wants of the priesthood. Here is [the assembly] of holy men, who keep the session of the rainy season, and who bring a blessing on [Ramana]ka, the donor.

*Notes.*

The word नेगम is here converted into नेकम. The translation of the last line, on account of its broken state, is only conjectural. The figure like दे at the end of line 4th I suspect to be a numeral for 100.

No. IX.

This inscription is on a small cave still further on.

सिध उतराहस द्तामितियकस योणकस धम देवपुतस इंद्राग्निद्तस धमतृण द्मं लेणं पवतासि रण्ञ्हि खानितं अभंतर च लेणस चेतिय घरो पोढियोच मतापि तर उदिस द्मं लेण कारितं सव बुध प्रजाय चतु दिश्स भिखु सघस नियतित स ह्पुतेन धम रखितेन

*Translation.*

To the Perfect One. This cave was excavated for religious persons in the wilderness, at the extremity of the mountains, by Indrágnidatta, son of Dharmadeva, prince regnant under Datamitraka, of the Northern region. Inside the cave is a dágoba, and there are cisterns also. This cave was made from respect to my father and mother, and gifted to all the followers of Buddha, the mendicant priesthood from the four quarters of the world, along with every one who is purified and preserved by religion.

*Notes.*

उतराह is probably उतराश. Near the end नियतित is supposed to be equivalent to निर्यातित, in the sense given. The truly Vedic names of this inscription point to a convert from Bráhmanism as the person who excavated this cave. Probably he was adopted by Datamitraka, a provincial raja, and by him made Yuvarája, in which sense I understand Yonaka. If योणक is for यवन, the difficulty will be got over in the same way, namely by adoption; as we have no reason to believe that the modern restrictions were attended to in these ancient times. Dhenukakatá, whom we are told was a Greek in one Kárle*n* inscription, had a Hindú Rishabhadatta, as mentioned in another, who stood to him in the relation of father.

No. X.

This inscription seems to have been executed at the command of some local prince.

भटपालिकाय लोमचस अगियतणकस भद्राकारक
राया मचगिरसु लय सवलिसि लने कण्ह दुदुतय महाहकसी

His son-in-law, Maháṛhakasi, excavated this all-desirable habitable cave in the Mancha Hills, in honor of King Bhadrákáraka, the retainer of warriors, whose hair stands on end with delight, and who is ever foremost in the conflict.

*Notes.*

This inscription may be imperfect, but of this I am not certain. सवलिसी I render by सर्वलिप्सा.

No. XI.

This inscription is of the same general character as the last.

यसभा राय कपणक मातुण चेतियघर पविते
ति रण्णमनि थपापित

*Translation.*

The renowned King Kapánaka established this Buddhist temple, for the benefit of his mother, in the wilderness near the extremity of the mountains.

*Notes.*

I have considered पवनेति the same as the पवताति of No. IX., and as equivalent to the पर्वतांते, which in Maráthi would be written पर्वतांति. If this be objected to, the word should be rendered consecrated.

No. XII.

This is over the cave of the wife of the Commander in Chief of the Emperor Yadnya S'rí, so often before mentioned—the last cave in the series.

[1] सिध राज्ञो गोतमीपुतस सामसिरी यज्ञ सातकणीस सवछरे सातम गह मतण पखे ततिय ३

[2] दिवसे पठमे केसिकस महा सेणापतिस भुवगोप साभरि जाय महासेणप तिय अथं लेण

[3] वोपकि यति सजमने सेपय चेसितलमने वहुकानी वकिसानि उकुते लय वेसण नीतो चतुदिसस चभिखुसघेस आवने दातति

*Translation.*

To the Perfect One. This Commander in Chief's cave (excavated by order) of Bhavagopa Sámbharí, wife of Kes'i, Commander in Chief of the Emperor S'rí Yadnya Sát Karni, descendant of king Gotamiputra, in the seventh year, during the third (3rd) demi-lunation of winter, on the first day. By Bopaki Yati, Sajamuni, Sepayá, and Sital Munís, Bahukáni, Vakisani;—by all of the aforesaid, admission to this comfortable abode is granted to the mendicant priesthood from the four quarters of the world.

*Notes.*

The proper names of the persons mentioned in the 3rd line of the incription are attended with difficulties. I have divided the words in the best way I could. These persons seem to have been of a kind of Panchávat, or Committee, to whom the affairs of the cave were intrusted. The original fac-simile gives मने and not मुने, and the change is made only on conjecture. The word दातति I understand to be a passive, notwithstanding that the termination seems opposed to this.

No. XIII.

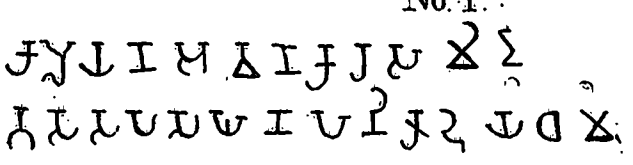
This concluding inscription is in the same cave, and in Sanscrit.

देय धर्म्मो उपासि
काय मर्म्मार्या लयनं

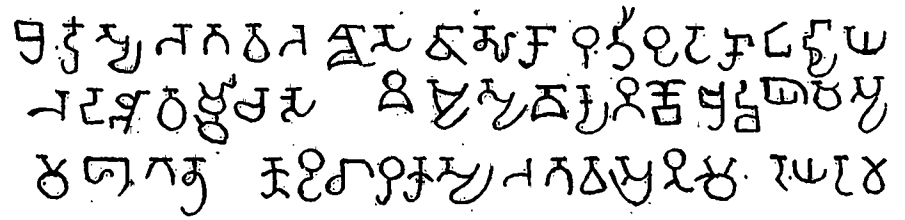
# INSCRIPTIONS
# FROM CAVES IN THE ISLAND OF SALSETTE
## REDUCED FROM IMPRESSIONS TAKEN BY
## LIEUTENANT P.F. BRETT.

ROYAL ... OF THE BOMBAY BRANCH OF THE ... ASIATIC ...

No. 1.



No. 2.



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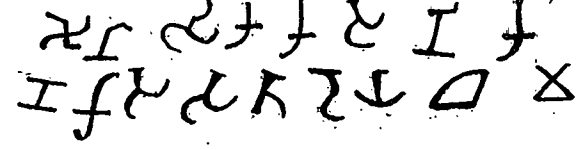
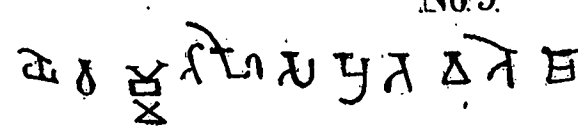


No. 5.



No 4.

No.6.



No.7.



No.8.

No.9.



No10.



No.11.

No.12

No.14.

No.13.

No15



No16



No17.



No18.

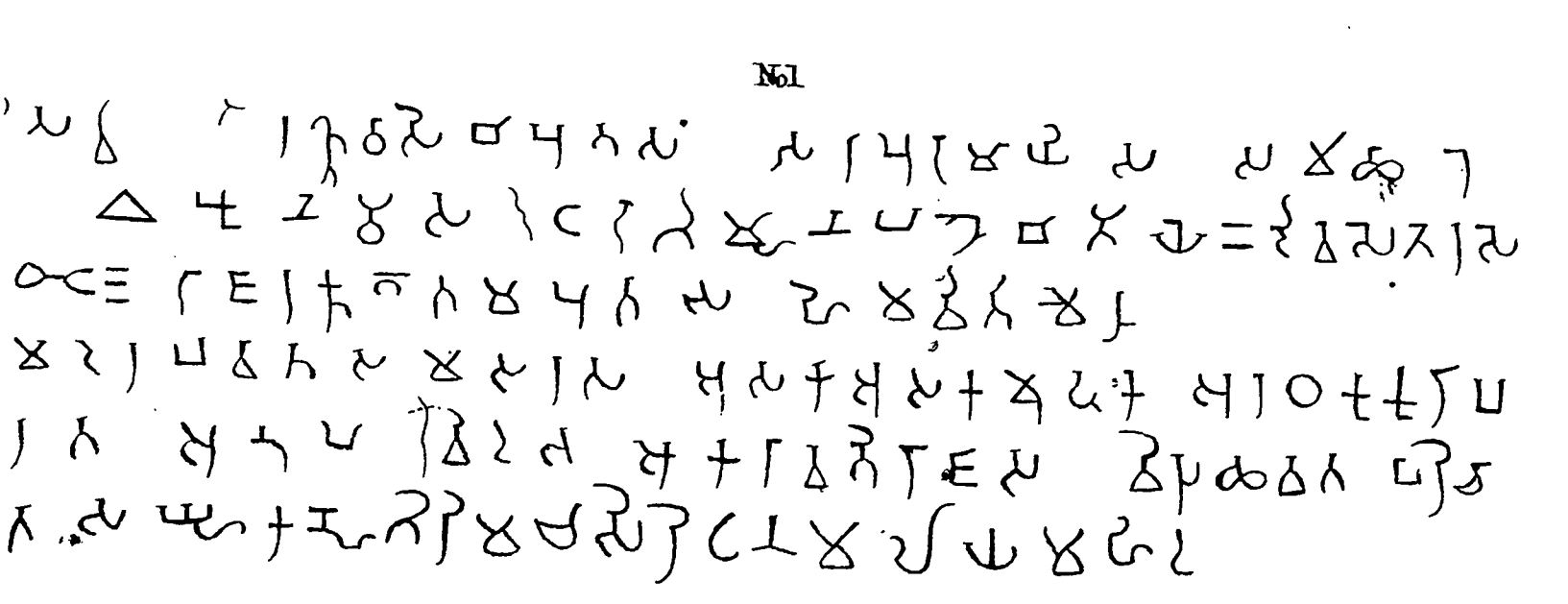
No.19.



No.20.

# INSCRIPTIONS
## FROM CAVES NEAR NASIK REDUCED FROM IMPRESSIONS TAKEN BY LIEUT P.F. BRETT.

No1



(3) ... ... ...

ספרי במדבר פרשת נשא

פרשת נשא את ראש בני גרשון גם הם למשפחותם לבית אבותם תפקד אותם
מבן שלשים שנה ועד בן חמשים שנה תפקדם כל הבא לצבא לעשות מלאכה
באהל מועד וזאת עבודת משפחות הגרשני לעבד ולמשא ונשאו את יריעות
המשכן ואת אהל מועד מכסהו ומכסה התחש אשר עליו מלמעלה ואת מסך
פתח אהל מועד ואת קלעי החצר אשר על המשכן ועל המזבח סביב ואת מיתריהם
לכל עבדתם ואת כל אשר יעשה להם ועבדו ועל פי אהרן ובניו תהיה כל עבדת
בני הגרשני לכל משאם ולכל עבדתם ופקדתם אתם במשמרת את כל משאם
זאת עבדת משפחות הגרשני לעבדה ולמשא על יד איתמר בן אהרן הכהן
ופקודיהם לפי מספר כל זכר מבן חדש ומעלה פקודיהם שלשת אלפים
וחמש מאות

(ז) [ו]אלה פקודי משפחת הגרשני אשר פקד משה ואהרן על פי ה' בדבר משה
(ח) פקודיהם למטות אבותם לבית אבותם מבן שלשים שנה ועד בן חמשים שנה כל הבא
לצבא לעבדת עבדה באהל מועד ויהיו פקודיהם לבית אבותם אלפים ושבע מאות
ושלשים

(ט) [ט]אלה פקודי משפחת בני גרשון לכל עבדת אהל מועד ופקדו משה ואהרן
(י) על פי ה' בדבר משה עבדת בני המררי למשפחותם לבית אבותם מבן שלשים שנה
ועד בן חמשים שנה כל הבא לצבא לעבדת אהל מועד ויהיו פקודיהם למשפחותם
שלשת אלפים ומאתים

(יא) [י]אלה פקודי משפחת המררי לכל עבדתם לאהל מועד קרשי המשכן ובריחיו
(יב) ועמודיו ואדניו וכל כליו לכל עבדתו ועמודי החצר סביב ואדניהם ויתדותם
ומיתריהם לכל כליהם ולכל עבדתם ובשמות תכתבו את כלי משמרת משאם
לכל עבדתם ואת כל אשר יעשה להם ועבדו ועל פי אהרן ובניו תהיה כל עבדת
בני הגרשני לכל משאם ולכל עבדתם ופקדתם אתם במשמרת את כל משאם
זאת עבדת משפחות הגרשני לעבדה ולמשא על יד איתמר בן אהרן הכהן
ופקודיהם לפי מספר כל זכר מבן חדש ומעלה פקודיהם שלשת אלפים
וחמש מאות

(כ) [כ]אלה פקודי משפחת בני גרשון לכל עבדת אהל מועד ופקדו משה ואהרן

(9) ולכן אין לנו אלא לומר שהוא מן הכלל ולא מן הפרט.

(10) ואם תאמר, הרי כבר נאמר בכלל ופרט וכלל, שכל שהוא בכלל ופרט וכלל אין לנו בו אלא מה שבפרט, ואם כן מה הוסיף לנו הכתוב בכלל ופרט וכלל?

(11) ועוד, הרי כבר נאמר בכלל ופרט וכלל, שכל שהוא בכלל ופרט וכלל אין לנו בו אלא מה שבפרט, ואם כן מה הוסיף לנו הכתוב בכלל ופרט וכלל?

(12) ועוד, הרי כבר נאמר בכלל ופרט וכלל, שכל שהוא בכלל ופרט וכלל אין לנו בו אלא מה שבפרט, ואם כן מה הוסיף לנו הכתוב בכלל ופרט וכלל?

(13) ועוד, הרי כבר נאמר בכלל ופרט וכלל, שכל שהוא בכלל ופרט וכלל אין לנו בו אלא מה שבפרט, ואם כן מה הוסיף לנו הכתוב בכלל ופרט וכלל?

(14) ועוד, הרי כבר נאמר בכלל ופרט וכלל, שכל שהוא בכלל ופרט וכלל אין לנו בו אלא מה שבפרט, ואם כן מה הוסיף לנו הכתוב בכלל ופרט וכלל?

ಕನ್ನಡ ಕಸ್ತೂರಿ ಕಾವ್ಯ ಪರಿಮಳ ಪ್ರಸರಣ ಕಾರ್ಯಕ್ರಮ

ಕಾವ್ಯ ಪರಿಮಳ ಪ್ರಸರಣ ಕಾರ್ಯಕ್ರಮ

II.

(1) [illegible]

(2) [illegible]

(3) [illegible]

(4) [illegible]

(5) [illegible]

(6) [illegible]

(7) ⵜⴰⵙⵙⴰⵏⵜ ⵏ ⵜⵎⵓⵔⵜ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ

(8) ⵜⵉⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ

(9) ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ

(10) ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ

(11) ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ

(12) ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ ⵏ ⵜⵎⵣⵡⵔⵓ

III.

(1) ...
(2) ...
(3) ...
(4) ...

IV.

(1) ...

IV.

(2) ... ... ...

IV.

(4) [illegible]

[illegible]

(5) [illegible]

V.

(1) [illegible]

(2) [illegible]

V.

(3.) [illegible]

(4) [illegible]

(5) [illegible]

VI.

(1) [illegible]

(2) [illegible]

(3) [illegible]

VI.

(4) [illegible]
(5) [illegible]
(6) [illegible]
(7) [illegible]

VII.

(1) [illegible]
(2) [illegible]
(3) [illegible]

VIII.

(1) 𐤁𐤓𐤀𐤔𐤉𐤕 𐤁𐤓𐤀 𐤀𐤋𐤄𐤉𐤌 𐤀𐤕 𐤄𐤔𐤌𐤉𐤌 𐤅𐤀𐤕 𐤄𐤀𐤓𐤑
(2) 𐤅𐤕𐤄𐤅 𐤄𐤀𐤓𐤑 𐤕𐤄𐤅 𐤅𐤁𐤅 𐤕𐤄𐤅
(3) 𐤅𐤄𐤀𐤓𐤑 𐤄𐤬 𐤔𐤌𐤕 𐤅𐤁𐤅𐤓 𐤏𐤋 𐤐𐤍𐤉 𐤕𐤄𐤅
(4) 𐤅𐤓𐤅𐤇 𐤀𐤋𐤄𐤉𐤌 𐤌𐤓𐤇𐤦𐤕 𐤏𐤋 𐤐𐤍𐤉 𐤄𐤌𐤬
(5) 𐤅𐤀𐤌𐤓 𐤀𐤋𐤄𐤉𐤌 𐤉𐤄𐤉 𐤀𐤅𐤓 𐤅𐤉𐤄𐤉 𐤀𐤅𐤓
(6) 𐤅𐤉𐤓𐤀 𐤀𐤋𐤄𐤉𐤌 𐤀𐤕 𐤄𐤀𐤅𐤓 𐤊𐤈𐤅𐤁 𐤅𐤀𐤕 𐤄𐤇𐤔𐤊 𐤒𐤓𐤀 𐤋𐤉𐤋𐤄

IX.

(1) 𐤅𐤉𐤀𐤌𐤓 𐤀𐤋𐤄𐤉𐤌 𐤉𐤒𐤅 𐤄𐤌𐤬 𐤌𐤕𐤌𐤓𐤉𐤌 𐤅𐤔𐤓𐤑𐤅 𐤔𐤓𐤑𐤬 𐤄𐤀𐤓𐤑 𐤔𐤓𐤑𐤬 𐤌𐤕 𐤅𐤔𐤓𐤑𐤅 𐤄𐤌𐤬 𐤅𐤉𐤔𐤓𐤑𐤅 𐤄𐤌𐤬 𐤅𐤉𐤔𐤓𐤑𐤅 𐤄𐤀𐤓𐤑
(2) ∴ 𐤅𐤉𐤀𐤌𐤓 𐤀𐤋𐤄𐤉𐤌 𐤉𐤒𐤅 𐤄𐤌𐤬 𐤌𐤕𐤌𐤓𐤉𐤌 𐤅𐤔𐤓𐤑𐤅 𐤔𐤓𐤑𐤬 𐤄𐤀𐤓𐤑 𐤔𐤓𐤑𐤬 𐤌𐤕 𐤅𐤔𐤓𐤑𐤅 𐤄𐤌𐤬 𐤅𐤉𐤔𐤓𐤑𐤅 𐤄𐤌𐤬 𐤅𐤉𐤔𐤓𐤑𐤅 𐤄𐤀𐤓𐤑
(3) 𐤅𐤉𐤀𐤌𐤓 𐤀𐤋𐤄𐤉𐤌 𐤉𐤒𐤅 𐤄𐤌𐤬 𐤌𐤕𐤌𐤓𐤉𐤌 𐤅𐤔𐤓𐤑𐤅 𐤔𐤓𐤑𐤬 𐤄𐤀𐤓𐤑 𐤔𐤓𐤑𐤬 𐤌𐤕 𐤅𐤔𐤓𐤑𐤅 𐤄𐤌𐤬 𐤅𐤉𐤔𐤓𐤑𐤅 𐤄𐤌𐤬 𐤅𐤉𐤔𐤓𐤑𐤅 𐤄𐤀𐤓𐤑
(4) 𐤅𐤉𐤀𐤌𐤓 𐤀𐤋𐤄𐤉𐤌 𐤉𐤒𐤅 𐤄𐤌𐤬 𐤌𐤕𐤌𐤓𐤉𐤌 𐤅𐤔𐤓𐤑𐤅 𐤔𐤓𐤑𐤬 𐤄𐤀𐤓𐤑 𐤔𐤓𐤑𐤬 𐤌𐤕 𐤅𐤔𐤓𐤑𐤅 𐤄𐤌𐤬 𐤅𐤉𐤔𐤓𐤑𐤅 𐤄𐤌𐤬 𐤅𐤉𐤔𐤓𐤑𐤅 𐤄𐤀𐤓𐤑

X.

(1) [illegible]

(2) [illegible]

XI.

(1) [illegible]

(2) [illegible]

## XII.

(1) [illegible]

(2) [illegible]

(3) [illegible]

(4) [illegible]

## XIII.

(1) [illegible]

(2) [illegible]

# Appendix from Dr Bird's Caves of Western India



Inscription on the large plate of Copper found in the Tope at Kanary, which was
opened by James Bird Esqre

# Table of letters and Syllables as exhibited in the Cave inscriptions.

| | |
|---|---|
| Satrap Characters. | a á i í u ú e am ah ka kha ga gha ch chha ja jha nyo ṛ t th d dh n t ṭ or h th d dh n p ph b bh m y r l v sh s s h |
| Older Dukhani letters. | |
| Later letters. | |

ka ká ki kí ku kri ke kai ko kam kah

ksha, khu or le vi di or de du rma rpa rthe

gři gra bhya po já ji sra pu pra

tá me má mo

# Table of Numbers.

| | Fractional Numbers | Old Indian Numerals | Satrap Numerals | Bactrian Syllables corresponding to these Numerals | | Indian Names of Numerals |
|---|---|---|---|---|---|---|
| 1 | — | | [illegible]? | [illegible] | ka | ek |
| 2 | ≡ | | | | | |
| 3 | ≡ | [illegible] | [illegible] | [illegible] | ti | tiń |
| 4 | | [illegible] | [illegible] | [illegible] | cha | chár |
| 5 | [illegible] | [illegible] | [illegible]? | | | |
| 6 | | [illegible]? | [illegible] | | | |
| 7 | | [illegible] | | | | |
| 8 | | | [illegible] | [illegible] | tta | ath |
| 9 | | [illegible] | | | | |
| 10 | | [illegible], [illegible] | [illegible], [illegible] | [illegible] | ja or dsha | dash |
| 20 | | [illegible], [illegible] | | | | |
| 30 | | [illegible] | | | | |
| 100 | | [illegible], [illegible] | [illegible], [illegible] | ... | | |
| 1000 | | | [illegible] | [illegible] | sa | sahasr |

*Translation.*

A religious assignation of a place for devotional meditation.

*Notes.*

The last word here आलयनं, or लयनं, is probably the original whence लेणं, the common name of such caves, is derived.

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In conclusion, some apology may be expected from me for undertaking these translations, now that copies of fac-similes are placed within reach of the learned world. I have only, then, to say, that ever since I came to India, an uncontrolable desire to examine such original documents as form the foundation of the history and institutions of the country has influenced me; and, possessing some local advantages for the study of these inscriptions, I have ventured to lay the fruit of my leisure hours before the Society. How far after previous failures, in a greater or less degree, I have in this attempt succeeded, must be left to the judgment of others; but I shall at least have directed the attention of Oriental scholars to the important historical bearing of some of the inscriptions on our caves, and may thus induce some learned Orientalist to give us a perfect version of them. The great leading facts relative to the Satraps of the Indo-Parthian Empire, the A'ndhra Emperors, and Balabhi sovereigns, are too prominently brought forward to admit, I apprehend, of hesitancy or doubt, and when the ancient history of India is written, will occupy in it a place suitable to their importance.

I look forward to a future opportunity of laying before the Society similar translations of the inscriptions found at Kárle*n* and Junír, and I trust also to be able to compare all the published copies of the fac-similes with the inscriptions themselves, which, in respect of those at Násik, I have been unable as yet to do, so as at last to get as perfect a copy of them as can be obtained in the present state of the rocks. As the fac-similes are the property of Government, and executed by another gentleman, I have done nothing more than to the best of my ability see that the lithographer executed his task faithfully. I have not even in my own Devanágari transcript corrected what I conceive to be errors, except in a few glaring instances, reserving that for the translation and the notes, in the latter of which I have generally limited myself to what was necessary to fix and show how I understood my text, not attempting to explain what Oriental scholars know better than I can teach them.

ART. III.—*Geology of the Nagpur State.* By the Rev. S. HISLOP.

Presented March 1853.

THE country around Nagpur has received more than an average share of attention from geologists; and when among these I mention the name of Dr. Voysey, it may appear presumptuous to propose, as I now do, to travel over the same ground. My object, however, in the following paper, is not so much to describe the physical features of the district, as to enumerate the organic remains which within the last two years have been found in it. The first of these fossils forced themselves on my attention in June 1851, when walking in company with my friend and colleague the Rev. R. Hunter, in the immediate neighbourhood of our residence. Had it not been for this unlooked for occurrence, and the opportunities we have since enjoyed at seasons of relaxation, and on our missionary tours, of becoming acquainted with similar relics in other localities; and, I may add, had it not been for the contributions of military friends, who kindly placed their valuable gleanings in the same field at our disposal, the notes here presented would not have been penned.

At the period when our first discovery was made, the state of knowledge in regard to the palæontology of the Nagpur territory I believe to have been this:—Mr. Malcolmson, in the progress of his investigations into the fossils of the Eastern portion of the great basaltic district of India, had in 1833 traced a freshwater deposit at various intervals through the north of the Nizam's kingdom into the southern part of the Nagpur Raja's dominions, though he does not seem to have suspected its existence in the immediate vicinity of the capital.* Again Lieutenant Munro some years after met with the impressions of pieces of fern in the sandstone near Kámpti, which were figured and described in the Journal of the Bombay Branch of the Royal Asiatic Society.† The result of this examination of the freshwater and sandstone formations within the Nagpur state was that Chikni, about

* Transactions of the Geological Society, vol. v. 2nd series.

† No. v. April 1843.

60 miles south of Nagpur city, was given as a locality for the *Unio Deccanensis, Physa Prinsepii, Paludina Deccanensis* and *Melania quadri-lineata ;* and Hinganghát, 16 miles nearer the capital, was said to abound in silicified wood ; while the fragments of fern discovered near Kámpti were supposed to approach nearest to the *Glossopteris Dancæoides* of Royle. From the imperfectness of the latter specimens, as figured in the journal, it is difficult to ascertain the exact character of the fossil found by Lieutenant Munro ; but, judging from fossils of the same locality that I have examined, I would hazard the conjecture that the generic name must have been rightly given, though not the specific, as the plant called *Glossopteris Dancæoides* by Royle is now admitted to be a *Tæniopteris.*

Our first discovery of a fossil within the territory of Nagpur was of a *Physa,* in the freshwater deposit enclosed in a trap hill about a mile west of Sitábaldi or the Residency, and two miles in the same direction from the native city. In a few days after, at the same spot, we met with the first bones and teeth, and after a week or two we brought to light on Tákli plain, about 2½ miles N.W. of Nagpur, the first-fruit, an entomostracon. About the same time, from observing the traces of ancient vegetation on the soft clayey sandstone used for whitening the sand-boards in our schools, we were led to the discovery of *Glossopteris* and *Phyllotheca,* and some seeds or seed-vessels, at Bhokára, six miles north of Nagpur. Shortly after, Mr. Hunter collected the first specimen of coleoptera, and being now joined by Captain Wapshare, Acting Judge Advocate of the Nagpur Subsidiary Force, many rare and interesting fruits were speedily added by his zealous and valued efforts ; while Lieutenant Sankey, of the Madras Engineers, with whom I visited Silewádá, about 12 miles north of Nagpur, which has yielded a great variety of the most beautiful specimens of *Glossopteris,* had the merit of finding in the Kámpti quarries, 9 miles N.E. of Nagpur, the first *Vertebraria,* along with two fine species of *Phyllotheca,* and a profusion of a kind of seed. At Korhádi, 7 miles north of Nagpur, Mr. Hunter and myself discovered, in the red shale that underlies the sandstone, tracks of worms, to which have been added more recently foot-marks, and the impression of what is probably a *Phyllotheca ;* and in a mission tour to the west, undertaken the first cold season after the commencement of our palæontological relaxations, we met with an abundance of fish-scales in the freshwater formation at Pahadsingha, 40 miles W.N.W. of Nagpur. Some time after our return we received an accession to our collection of shells from Dr. J. Miller, then of the 10th Regt. M. N. I., who had found the same freshwater formation at Machhaghodá, 100

miles north of Nagpur, and also from Mr. Sankey, who had fallen in with it at Pilkápáhád, 25 miles to the N.W. The same gentleman, along with Dr. Jerdon, subsequently visited Machhaghodá, whence, in addition to the coal fossils of that district, which they were the first to bring to notice, they returned laden with many well-preserved shells and specimens of wood similar to what occur in the neighbourhood of Nagpur, along with fragments of the freshwater rock, in which was detected a peculiar form of entomostracon. During the first twelve months of observation, while directing attention especially to the organisms of the sandstone and freshwater formations, we could not fail to observe occasionally the more recent remains of quadrupeds and shells that were presented to us in comparatively modern deposits. Last year, while out on our annual tour in a S.E. direction from Nagpur, besides the discovery of an extensive iron district, surrounded by a country abounding in laterite, we increased our list of fossils by adding some coniferous remains and bivalves from the sandstone.

Having made these remarks by way of a historical introduction, I may now briefly glance at the superficial extent and superposition of the rocks in which the fossils occur. Our principal observations have been made within an area which, having the city of Nagpur for its S.E. corner, is spread over a square with a side of 10 miles. At the same time we have had facilities, either personally or by the aid of friends, of becoming more or less acquainted with the country in a straight line from Nagpur towards the four cardinal points to the distance of 80 miles or upwards. This distance nearly carries us to the limits of the Nagpur kingdom on all sides but the east, in which direction the frontier is much further removed from the capital. If we conceive a circle drawn around Nagpur with a radius of 80 miles, and the surface of that circle divided into four parts by means of lines passing through the city due north and south, and east and west, then the quadrant between the south and west would be occupied exclusively by black soil and trap rocks; that between west and north would be chiefly occupied by the same, though towards the centre of the circle diversified by patches of sandstone, with a sandy loam on its surface; while the remaining two would be characterised for the first 30 or 40 miles by igneous stratified and massive rocks, which in several places protrude from under a deep soil, for the most part black, but in some instances red, beyond which lie occasional tracts of sandstone in the lower districts, and metamorphic strata in the more elevated regions, both very frequently covered by a red soil and laterite.

In taking a combined view of the rocks which occur within the circle just described, the following seems to be the descending order in which they succeed each other:—I. Recent formations, consisting of black or red soil, both being mixed with kunkur, and the latter frequently containing strata of sand and gravel, with the remains of shells and quadrupeds, little if at all distinguishable from existing species; II. Laterite; III. Overlying trap with nodules; IV. Fresh-water deposit; V. Vesicular trap, that has been in many cases injected into the preceding, and is obviously of an origin subsequent to the overlying trap; VI. Sandstone formation, consisting of 1*st*, upper beds, that are sometimes soft and friable, and of a white and red colour, or that are hard and gritty, and pervaded by iron bands; 2*nd*, middle strata, of a fine fissile structure, and gradually becoming coarse as they approach the 3*rd*, inferior beds, which much resemble the upper ones, except that they contain no iron; under which (4*th*) occur green and red shales; VII. Limestone formation, which within our area is crystalline, and mixed with magnesia; and VIII. metamorphic and granitic rocks.

I. *Recent Formations.*—1*st*. Black soil, or Regur (in Maráthi *Kanhára*) has yielded no organic remains to our imperfect researches, but I feel persuaded that those who are well supplied with apparatus will yet have the pleasure of detecting some microscopic animals in it. I have never been able to acquiesce in the now generally received theory that accounts for it by deposition in water. It seems far more probable that it is the product of luxuriant vegetation in a moist atmosphere, which has grown and decayed in the localities where it is found. This supposition would harmonise with all the appearances of stratification which it undoubtedly exhibits, and, at the same time, preserve its similarity to the *Tchornoizem* of Russia, which has lately been shown by Ehrenberg to contain several forms of *Polygastrica* and *Phytolitharia*. In the kunkur, which is mixed with the lower portion of the regur, bones are occasionally found; but though they look ancient enough from the thick coating of lime with which they are encrusted, they do not appear to differ from the bones of the modern ox and sheep. Besides, I have never found such remains so far from the abode of men as to free me from the suspicion that they belonged to animals in a domestic state.

2*nd*. The red soil, which generally takes the place of the regur in sandstone and metamorphic districts, is sometimes seen on the banks of rivers to be of great depth. It alternates not unfrequently with layers of loose sand and gravel, which contain existing fluviatile shells

of the genera *Unio, Cyrena,* and *Melania.* These shells have undergone no change since they were alive, save that they have been subjected to attrition, and bleaching by water and the atmosphere. In the district west of Nagpur, the rivers often expose a bed of sand and gravel cemented by a small quantity of lime, and in its hardened state furnishing blocks two or three feet thick of sandstone or conglomerate, as the case may be. In this stratum near the Kolár river, about 10 miles north of Nagpur, there occurs an abundance of *Paludina, Melania,* and *Cyrena.* These, unlike the fluviatile shells before mentioned, have undergone a decided change. In some instances their cavities are filled with the siliceous and calcareous matter of the matrix, but in most cases the shell has completely disappeared, leaving only the internal cast. On the banks of the Sarpan river, near Tondakheiri, 14 miles N.W. of Nagpur, there is an accumulation of shells mingled with bones. The shells are partly of a fluviatile character, including *Unio* and *Cyrena,* but on the other hand they present a numerical preponderance of such as are generally found in lacustrine situations, such as *Bithenia, Limnæa,* and *Planorbis.* They were slightly petrified. The bones found in connection with these shells consisted of jaws, vertebræ, and other parts of mammalia ; but I regret to say they were accidentally destroyed before they could be examined. Rising to the surface of a thin kunkuraceous gritty deposit in the plain of Tákli, were observed the remains of a large animal, the bones of which were completely petrified, but after petrification, had been so much affected by the weather as to fall to pieces on being removed. These are all the bones that have been found near the surface, unless we here include part of a femur 2 inches, and a phalanx one inch broad, discovered at Junyápání Chouki, 5 miles west of Nagpur. I am, however, inclined to suppose that they had been washed out of the freshwater deposit enclosed in trap.

II. *Laterite* (in Maráthi *Murmádi*).—This formation spreads over a large area to the east of Nagpur. It is now known to stretch with several intervals from Pawani to Chándá, a distance north and south of at least 60 miles. It is also seen at Máhonda, on the Khanari river, which is to the north of Pawani, and how far it extends north of this has not yet been ascertained; but I believe it is found more or less up the Wein Gangá till near its source, and joins on with the large development of the same rock that can be traced in the Jabalpur district. Its breadth from east to west has not been determined. When such a large area is assigned to this rock, it is not meant that there is a great thickness of it observed everywhere on the surface. In some places it is found of a thickness of 5 feet, and in others it is

known only by a few pebble-shaped nodules washed out of the soil. But in many localities the blocks of laterite are visible only on the rising ground, which is covered with jungle, while in the cultivated hollows they disappear under a surface soil of red sandy clay. That they are there, however, can be ascertained by inspecting the banks of rivers in laterite districts, where the brown porous rock may be detected at a depth of 30 feet from the general level of the plain. Laterite is seen to overlie all sorts of rocks. It is equally present above sandstone and gneiss. The theory, therefore, which supposes it to be the product of the latter rock decomposed, is altogether without foundation. To point out a better mode of accounting for it is not so easy. But in a late tour through a metamorphic district abounding in iron ore, which was also characterized by the extent of its lateritic formation, the idea occurred to me that the two might possibly be connected with each other as cause and effect—that, in short, the ferruginous matter coming up from among the metalliferous strata might, by the agency of water, have impregnated every decaying rock on the surface, which, with the subsequent infiltration of rain, would then present the appearance of laterite, as we now find it. In the rocks of this formation east of Nagpur no fossils have as yet been discovered; but diamond mines have been opened in them. I perceive that Mr. Malcolmson inferred the identity of the sandstone of Central with that of Southern India, commonly called the diamond sandstone, from the existence of diamonds at Weirázad, a town about 80 miles S.E. of Nagpur.* On recently visiting that locality, Mr. Hunter and I found that there was no sandstone whatever in the neighbourhood, and that the gems had been extracted from a lateritic grit overlying quartzoze rock. I am not sufficiently conversant with diamond districts to make any universal assertion on the matter; but I would suggest it as a subject worthy of inquiry, whether the condition favorable for the discovery of diamonds is the presence, not of any subjacent rock, either metamorphic or sedimentary, but of ferruginous clay in the grit or conglomerate which constitutes the diamond matrix. This is the impression left on my mind by what I have read of the diamond mines at Ovalampalli and Kondápetta, near Cuddapa, and the diamond washings in the Mahánadi, near Sambalpur.

III. IV. and V.—I shall not here enlarge on the overlying and underlying trap, which, as they present objects interesting chiefly to the mineralogist, do not come within the scope of this paper.

* This Journal, No. v. 1843.

But before proceeding to the consideration of the fossiliferous fresh-water formation that lies between them, I may be permitted to refer to some supposed petrified fruits that are picked up at *Gidad*, about 40 miles south of Nagpur. On the top of a trap hill near this place is a tomb, said to be that of Shek Jarid, whose fame is spread far and wide among the Musalmáns of India. Newbold tells us that for twelve years he is asserted to have inhabited a cave at Kadri, near Mángalur, after which he disappeared, and was never more heard of. Perhaps he came to Central India; for if we are to believe tradition, his mortal remains lie buried at *Gidad*, and attract crowds of pilgrims, both Hindús and Musalmáns. But unhappily for the credit of the marvels associated with his name, it is maintained by these followers of the Prophet from the north-west, that the Fakir lived and died among them, and that his tomb still exists in that part of the country. Among the wonderful stories related of him, while he is said to have dwelt at *Gidad*, it is reported that one day a Banyan passed his resting place with bullocks laden with nutmegs, betelnuts, and other such commodities. The Fakir, as is customary with his class, demanded a share of the contents of the goni-bags; but the Banyan, reluctant to part with his property, and, at the same time dreading to encounter the mendicant's wrath, replied that the bullocks were laden only with stones. "Stones let them be," rejoined the irritated saint, and the Banyan drove on his cattle. But by-and-bye the bullocks began to exhibit symptoms of the utmost distress. One after another fell down under the weight of its now ponderous burden. The Banyan, seeing his mistake, returned to the Fakir, and, entreating his forgiveness, earnestly besought him to withdraw his curse, and restore his wares to their original condition. At his command he emptied the sacks, and filled them anew with leaves from the neighbouring trees, which, after he had advanced a little on his journey, were found to be all converted into gold mohurs and rupees. The spherical and oval stones that are now met with scattered around the spot are the veritable petrified fruits that the Banyan left behind, and to this day bear witness to the truth of the transaction. This fable, though received by Hindús with their usual love for the marvellous, is evidently of a common origin with a similar legend current in Palestine. Instead of *Gidad* Hill read Mount Carmel; for Shek Jarid substitute the prophet Elijah, and the merchant with his nutmegs and betelnuts change into a gardener with melons; and the two stories, in their main features, are identical. After this I need scarcely add that the so-called petrifications, that attest the reality of the miracle exhibit no trace of the vegetable struc-

ture of genuine fruits, but are simply nodules of zeolite, that have issued from the trap cavities in which they were formed.

The *Freshwater Formation*, which really does yield fossil fruits and other organisms, is nearly co-extensive with the great outpouring of basalt on the west of Nagpur. Whether it ever existed where there is now no trap to be seen is a question which I shall not stop to discuss. But it is a remarkable fact, that wherever there is overlying diorite to preserve it, there the freshwater deposit is almost sure to be found, unless it has been burnt up by the intrusion of amygdaloid. We have traced it well nigh without interruption for 100 miles towards Elichpur, and throughout the whole distance differing often in colour and composition, in outward appearance and inward structure, but still maintaining the same general relation to the enclosing rocks. It is to be met with of all hues, and of all mixtures of tints: at one place it is calcareous, at another siliceous, and at a third clayey. Here it is crystalline, there cherty, and again scoriaceous. In one spot it is full of fossils, in another and neighbouring locality it is utterly devoid of all traces of ancient life. I know not one intrinsic feature that is characteristic of it. In judging of its identity, the only sure guide to go by is its position between the nodular trap above and the vesicular trap below. Though it must be spread over vast table-lands of different elevations, yet it is almost exclusively on the escarpments of these that we can acquire any knowledge of it. Generally the imbedded stratum occurs at a distance of 15 to 20 feet from the flat top of the eminence, just at the place where the water in the monsoon, running down the slope, has gathered strength sufficient to make an impression on intervening barriers, and whence it proceeds to plough up the soft deposit, and the still softer subjacent amygdaloid, till it reaches the bottom, leaving an interval between each runnel like a rounded talus. In making your way up the ascent, your attention may be attracted by a number of blocks at the foot, which have fallen, or been washed down, from the site of the deposit. These increase the nearer you approach the exact spot; and if they suddenly cease, you may be sure, whether you have observed it or not, that you have just passed by the stratified rock, and come upon the nodular basalt. The thickness of the deposit is very various. It ranges from 6 or 7 feet to an inch. The former must have been its original development in this part of India; and where it has been reduced, the change must be attributed to the amygdaloidal intrusion from beneath. In the neighbourhood of Nagpur it does not average a thickness of more than one foot: where it is greater, the upper portion is generally indurated, and the

lower remains soft. It is in the former that most of the fossils are found, though where the latter consists of a green and purple clay, the calcareous nodules, which have been aggregated in it, for the most part enclose organic remains. Among the fossils which this formation yields are the following :—

*Mammalia or Reptilia* (?)—In addition to the part of a femur and the phalanx, before alluded to, as having been found at Junyápáni Chonki, which I am inclined to refer to this deposit, there have been discovered in it, about two miles west of Nagpur, a portion of a vertebral column, consisting, apparently, of eight vertebræ, and, not far from the same spot, a number of minute bones, in a detached and very fragmentary state, belonging to all parts of the animal structure. Whether these remains of quadrupeds are exclusively of reptiles, or whether some of them may not also be mammalian, I do not possess knowledge enough to warrant my expressing an opinion ; nor is it necessary that I should, seeing they are to be transmitted to London, and will soon be examined by those who are competent to the task. But I may mention, that the teeth discovered among them indicate the former existence of saurians at the locality, one tooth being small and obtusely conical, with a barbed point, and another species, which is very abundant, being comparatively flat and lancet-shaped, with the enamelled side of a darkish slate colour. To this class also may, perhaps, be referred a claw, half an inch long, brought to light at Telankhedi, three miles west of Nagpur ; while the stratum at Machhaghodá has furnished the impression, apparently, of a freshwater tortoise.

*Fishes.*—Remains of this class are found at Tákli and Machhaghodá, but chiefly at Páhádsingha. They consist for the most part of scales, some of the Ganoid and others of the Cycloid orders. The Ganoidians are probably to be referred to the Lepidotoids, to which the spinous rays collected with the scales may have belonged. The alternate depressions and elevations, which radiate from the centre of the Cycloidian scales, are beautifully preserved ; some have 12 of each, and others a smaller number. One specimen, as was pointed out to me by that well-known naturalist Dr. Jerdon, has constituted part of the lateral line, and still bears the tube through which the mucus flowed that anointed the surface of the body. But the most curious object that has been met with in this department is a piece of a roe found at Tákli, in the two lobes of which the ova that had been matured are calcedonised, while countless minute granules are seen lining the ovarian membrane.

*Insects.*—The exuviæ of this class are more numerous than might have been anticipated. They are found only at Tákli, and are chiefly elytra of beetles, of which 9 species have been discovered, 7 having rewarded the investigations of Mr. Hunter. Some are allied to the Buprestidæ, another, in the opinion of its accomplished discoverer, is connected with the (soft-bodied) Heteromera, while two tuberculated elytra may possibly have belonged to some other family of the same tribe. In one of the fruits, to be mentioned below, there was found a hollow tube binding together several of the surrounding seeds, and absorbing the juice of their enveloping pulp: this was, perhaps, the work of some one of the Dipterous order; and on a piece of silicified wood, which at the period of its deposition must have been considerably decayed, there was discovered a large number of little round opaque bodies, regularly arranged in a hollow. Can these have been the eggs of one of the Lepidoptera?

*Crustacea.*—Of this class no order occurs except the Entomostraca, comprising the genus Cypris, with 6 species, all new, so far as I am aware; and a very interesting genus, which I am disposed to consider allied to *Lynceus* or *Daphnia.*

*Mollusca.*—These are very numerous, consisting of *Melania quadrilineata* (Sowerby), and perhaps another species of the same genus not described; *Paludina Deccanensis* (Sow.) and 8 species not named; 4 species of *Valvata,* new; of *Limnæa,* besides the *subulata* (Sow.) 5 new species; of *Physa* in addition to the *Prinsepii* (Sow.) 4 or 5 new forms, that may constitute as many species; of *Bulimus* 2 new species, with 12 other species that may be referable to the same genus; *Succinea* 1 species, and *Unio Deccanensis.* Most of the Paludinæ have been found at Tákli, along with the two well-marked species of Bulimus. Telankhedi has supplied all the Limnææ, the doubtful Bulimi, which in many cases retain a stripe of colour on the shell, and the single species of *Succinea,* of which only one specimen has been met with. One species of *Valvata,* with a pretty striated spire, most frequently truncated, is found exclusively at Tákli. Another, also striated and conoid, leaves its impressions abundantly on the rock around Nagpur. Two without striæ occur at Machhaghodá, one carinated above and sometimes conical, and at other times oblong-conical, and the other discoidal, and so minute as scarcely to be visible by the naked eye. *Physa* is the genus most extensively diffused, having been collected in all places where the deposit is fossiliferous. Besides the *P. Prinsepii* (Sow.) there is one new form found at Telankhedi, which presents obvious specific differences; and there

are several others varying from both of these, but by such gradual changes, that, under a sense of incompetency, I have sent them all to London for determination. The only remaining shell that has fallen in our way is *Unio Deccanensis*, (Sow.) which was obtained by Mr. Hunter at Chikni, the locality pointed out by Malcolmson, which is the only locality for it that I as yet know of within the territory of Nagpur. The specimens of it that occur there are far from good, when compared with those kindly sent me from the neighbourhood of Elichpur by Dr. Bradley. That able and zealous geologist has also furnished me with excellent specimens of *Physa*, the forms of which agree with those common in the vicinity of Nagpur.

We pass now to the vegetable kingdom, the specimens of which from the freshwater formation are both rare and varied. They may be classed under the heads of fruits and seeds, leaves, roots and wood.

*Fruits and Seeds.*—Of these there are about 50 species. The order of the Exogenous sub-kingdom, that has most representatives, is the *Leguminosæ*, there being 4 species very obvious, viz. two *Hedysareæ*, and other two, including a *Cassia* of the more regular flowered division of the order. Under the same head may be arranged what appears to be a *Faboidea* of Bowerbank, a double-seeded fruit resembling the *Xylinosprionites* of the same author, and a three-seeded one, occurring sometimes with two seed-vessels, and at other times with three, which may have been a *Hedysarea*. The most abundant order of Endogens is *Aroideæ*, of which there are two genera, with compound fruits, one with three-seeded ovaries, in size and outward appearance being exceedingly like a small pine-apple, and the other genus bearing a distant resemblance to a mulberry, having, however, the seeds in each vessel symmetrically disposed in sixes. This latter genus contains two species: one, that must have had a rich purple pulp, was upwards of an inch in length and half an inch in breadth; and the other extended to 2 inches long, with a breadth not exceeding $\frac{1}{8}$ of an inch. Next to the *Aroideæ* the most interesting Endogens are *Palms*, of which there seem to be two genera, one a *Nipadites*, (Bow.) and the other one a transparent piece of calcedony, whose place in the order cannot exactly be assigned. For the latter rare specimen, as well as for the larger mulberry-like aroid fruit, and many other fruits and seeds, we are indebted to Captain Wapshare, whose co-operation in this field has proved of the highest value to Indian palæontology. The fruits above specified, in common with those not mentioned, are almost all found at Tákli. The only exceptions worthy of notice are one of the *Hedysareæ*, which was laid open in a stone from Machhaghodá; separate ovaries of the larger six-seeded

aroid, which are found along with fish-scales at Pahadsingha, and the *Chara Malcolmsonii*, which is met with, though not abundantly, wherever the deposit contains organic remains.

*Leaves.*—Of these there are 12 kinds, seven of which are Exogenous. In some of these the secondary veins strike off from the primary at a very acute angle, and in others not so acute, while in one of orbicular shape they radiate from a central point like the leaf of *Hydrocotyle*. The Endogenous leaves are five in number, some of which possess a considerable similarity to those found in the Bombay strata, and figured in Plate viii. of this Journal for July 1852. All these have been obtained at Tákli, as also the roots.

*Roots.*—These amount to five in all, none of which are much above an inch in length. The most conspicuous forms among them are those that are somewhat like a cocoon, marked by the scars of sheathing bracts. Of such tubers there seem to be three, differing in certain respects from each other, and agreeing in number with the three aroid plants, with which they are found invariably in juxtaposition. The similarity of one root in all but the size to that given in Plate vii. fig. 1 of the able paper just referred to cannot fail to appear on the most cursory examination, and may serve to fix the place of the latter in the vegetable kingdom, as well as create the hope of finding near Bombay some aroid fruit which it has produced.

*Wood.*—There seem to be three kinds of Exogens and two of Endogens. In some cases the former retain their bark, while the latter, as has been observed in other Indian localities, occasionally display their aerial roots. Specimens of wood are common in almost all fossiliferous parts of the territory.

From a review of the whole fossil contents of this formation, the inference to be derived appears to be, that it cannot be more recent than the Eocene era. Brown, in his Index, has set it down as of the same age with the Continental *Molasse ;* but the facts, that out of the many shells it has embedded not one within my knowledge is specifically the same as any now existing, that there is almost an equal number of Ganoidian with Cycloidian scales, and that the fruits bear a remarkable resemblance to these found in the London clay of the Isle of Sheppey in my humble opinion fully warrant the belief that it is one of the oldest of tertiaries. On the tempting theme of its extent throughout India I forbear to enter.

VI. *The Sandstone Formation.*—The next fossiliferous formation occurring in the Nagpur territory is composed of beds of sandstone. The uppermost strata, called in Maráthi *Kharpá*, are frequently sepa-

rated by an iron band, styled *Khatu*, from the middle ones, which go by the name of *Párshá*. These, as formerly mentioned, are succeeded by lower beds, which, like the superior strata, are called *Kharpá*. The average depth of the upper strata may be 25 feet, and of the middle 15 feet. That of the inferior beds is unknown. Though there is a general conformability between the highest strata and those beneath them, the latter have been broken up at Bhokára, and the same thing must have happened in the neighbourhood of Kámpti, if we may judge from the number of angular, as well as rounded fragments that have been deposited about the period when the formation of the uppermost beds was terminating. It is in these embedded blocks that the most valuable of the Kámpti fossils are discovered. Lower down in the highest strata, just before reaching the usual position of the iron band, the first organic remains are met with *in situ*. They are compressed stems of trees, one of which, presenting its thin edge in the side of a quarry at Silewádá, may be traced for about 20 feet. But it is under the iron band in the fissile slabs of the middle beds, which are much used for architectural purposes, that most of the fossils lie.

In the sandstone, as yet, there have been discovered no animal remains but those of—

*Mollusca*.—These occur only at Mángali, 60 miles south of Nagpur, and consist of two species of minute *Cyrena*, (?) one, which is the smaller, being globular, and the other flatter and more elongated.

The vegetable remains are exceedingly abundant, and are to be found in all places where the middle beds appear. They have also been recently discovered in a similar position near Elichpur, by Dr. Bradley. As they are met with at Nagpur and the surrounding country, they include seeds, leaves, and stems.

*Seeds*.—Four species. Of these the first two discovered were found at Bhokára. Notwithstanding their being smaller, they are evidently related to two of the forms of *Carpolithes* figured by Lindley and Hutton in their *Fossil Flora*, vol. iii. p. 193. The third kind of seed was first met with at Kámpti, by Mr. Sankey, to whom I am under many obligations for this, as well as other favours. Shortly after Captain Wapshare and I found it at Tondakheiri, 14 miles N.W. of Nagpur. A fourth seed, which occurs at Silewádá, is lanceolate, and very minute. Under this head may, perhaps, require to be comprehended a circular depression, resembling in size and form the impression left on wax by a pretty large key, which was discovered by Captain Wapshare at Bhokára.

*Leaves.—Dicotyledonous* 2. One a leaf of a conifer, about 1 inch long and $\frac{1}{4}$ inch broad across the middle, midrib included. It has obviously been a strong inflexible leaf, and with its sharp point may have been rather formidable. A small piece of *Zamites* from Kámpti, not $\frac{1}{2}$ inch long, and yet it gives off from its tiny midrib 20 pennules, each containing 6 or 7 microscopic veins. There are several leaves observable in the strata at Kámpti, apparently *Monocotyledonous*. One kindly contributed by Mr. Sankey is 17 inches long and $\frac{3}{4}$ inch broad. Before deposition it had been split in two for about two-thirds of its length. It may possibly be the leaflet of a large *Zamites ;* but I am disposed to consider it rather a *Poacites*, with very minute venation. The same may be said of another curious object, which has left 42 parallel lines stretching across a confused mass of vegetation, for a distance of 3 inches, and with a breadth of $\frac{3}{4}$ of an inch.

But the most common and beautiful leaves which the sandstone formation produces are the fronds of Ferns. They include—

*Pecopteris.*—Of this genus but few specimens have been found, and these at Kámpti only. They are, however, of two distinct species. A pinna belonging to one of these species is furnished on each side with 11 pinnules, endate at the base, and with a central vein, reaching to the apex. A specimen of the other species is very perfect, and presents four bipinnate fragments, lying together in such a manner as to indicate a tripinnate frond, pinnæ with from 8 to 10 pinnules on each side, the venation much branched, and without a central vein extending to the apex.

*Glossopteris.*—The species of this genus are very numerous, amounting to 10, and all in excellent preservation. With their large iron-coloured fronds and distinct veins, and in several instances with their perfect fructification, they form the most interesting fossils of the vegetable kingdom that I have ever seen. The species differ from each other in size, shape, venation, and arrangement of the sori. One of them is upwards of 20 inches long and 3 broad, while some slabs are entirely covered with a species little more than 3 inches in length. Some have the venation coarse, others fine ; some have it starting from the midrib at a very acute angle, others nearly at right angles. The sori in all cases are dot like ; but in some they are large and round ; in others they are small and elongated ; in some they are placed chiefly along the margin, in others with 4 or 5 rows : they fill up almost the whole of the frond. This genus is the most widely diffused of any in the formation within the Nagpur state. It has been

found at Chándá, and also at Chorkheiri, a distance of 120 miles, and at intermediate places. The locality that has furnished most species is Silewádá, whence I was favoured with a magnificent slab by Captain Wapshare.

*Cyclopteris.*—One species of this genus has been discovered at Tondakheiri, along with the coniferous leaf: length 2½ inches, breadth 1 inch. The frond is crowned with fructification in form like the flower of a cultivated cockscomb. Another species met with at Kámpti is much larger.

*Sphenopteris.*—The specimens of this genus which are imbedded along with those of *Pecopteris* are much mutilated; but the small fragments that are found exhibit a very elaborate, though clear, venation.

*Tæniopteris.*—Two species, one narrow, with secondary veins straight and perpendicular to the median, the other very broad, with secondary veins, curved and oblique.

*Stems.*—These are very abundant at Silewádá, including genera of which I can find no traces in any *Fossil Flora* to which I have had access. They are apparently *Exogenous*, but do not preserve the structure of the wood. They have possessed a well-defined bark, which is often obliquely striated, and exhibits the cicatrices of leaves, with a bud occasionally left after the foot-stalk had fallen off. Some of the scars are longitudinal; others are transverse, and embrace a considerable part of the stem. They are in general sparsely distributed, in one large stem 3 feet long, and upwards of a foot broad, there being only a single scar apparent. Besides these *Exogenous* stems, of which there are four or five different genera, there was one discovered at Mángali, along with *Cyrenæ*, which can be distinctly referred to the conifers, from the lattice-like disposition of its scars. The wood of a coniferous stem, converted into silex, but retaining no traces of its bark, was dug out from the road near Chándá. Other stems, preserving the wood, but so altered by iron that the structure cannot be determined further than that it must have been *Exogenous*, occur in abundance at Silewádá. On the other hand a stem embedded in the rock at Mángali exhibits every mark of having been *Endogenous*. The portion obtained is like a thin rattan, 14 inches long, without any apparent joint. Under this sub-kingdom must also be classed—

*Equisetites*, or according to Bunbury *Asterophyllites*.—The peculiarity of the specimen of this genus which was discovered by Mr. Hunter at Silewádá, as well as of a Yorkshire one, figured in the *Fossil Flora* (vol. iii. p. 186), under the name of *Equisetum laterale*, is that it is

always found associated with little round discs, having "lines radiating from a common centre, something like the phragma of a calamite." The authors of the *Fossil Flora* were uncertain whether the discs belonged to the stem, near which they are found; but in the Silewádá specimen, the round bodies, of which there must have been two and two opposite each other at the articulation, partly retain their original position, and partly have fallen out, leaving a radiating hollow to show where they once had been. A very common plant at the deposition of the sandstone was the—

*Phyllotheca.*—In giving this name to the genus that has hitherto been called *Calamites* in India, I follow the high authority of Brongniart and McCoy, who have described specimens from Australia. The opposite sulcation of our Indian genus clearly separates it from *Calamites*. What place it ought to hold in a classification remains doubtful. Göppert ranks it among Monocotyledons, immediately after *Equisetites*, while McCoy compares it with the *Casuarina*. I have not been able, in the numerous specimens which I have met with, to verify the opinion of the latter eminent geologist, not having detected either bark or a phanerogamous fructification. There appear to be in all nine species collected from Bhokára, Silewádá, and Kámpti, differing in the number of *sulci*, which range from 6 in the semi-circumference to 31. Two from Kámpti were sent to me by Mr. Sankey, and one from Silewádá by Captain Wapshare.

*Vertebraria.*—This is the strangest genus among our Nagpur fossil plants. Hitherto it has been described from specimens obtained exclusively from the Indian and Australian coal-shale. This has led to a limited view of its nature. McCoy's generic character applies merely to the radiated body, which is found in connection with the main stem, and which he believes to be made up of a "slender stem surrounded by densely aggregated whorls of verticillate cuneiform leaves, having a dichotomous venation." Of the correctness of this description of what was before the author at the time, I have no reason to doubt, but it is quite inappropriate, when it comes to be predicated of the sandstone specimens. These have no slender stem or densely aggregated whorls of leaves. On the contrary, the main stem is thick, marked with two rows of oblong, rounded, or angular elevations and depressions, and giving off branches and twigs at different intervals, and in all directions. Mr. Sankey forwarded to me the first sandstone specimen from Kámpti, and in the same week I found it at Tondakheiri, and more recently at Chándá.

Such are the principal fossils of the Sandstone, properly so called.

Beneath it occur some beds of Shale, which may be held as part of the same formation. These strata are developed in the district north of Chándá, and between Koohádi and Bhokára, where the red shale contains the following organic remains :—

*Reptilia ?*—A footmark, of ⅓ of an inch long, and as much broad, with the impression of five (?) claws. Three specimens have been obtained, each exhibiting only one print. The shale, which is very brittle, does not admit of a surface of more than a few square inches being procured. On the same specimens as bear the footmarks are seen the tracks of—

*Lumbricariæ* (Earthworms).—That these animals have been of the nature here indicated will be evident to any one who considers the appearance of the furrows : the way in which the head has occasionally been pushed forward, and then withdrawn ; the tubular holes by which the ground has been pierced, and the intestine shaped evacuations which have been left on the surface. Worm borings have been found in the green shale of Tadádi, 70 miles south of Nagpur.

The only vegetable organism which has been discovered in the shale is a sulcated plant, which most probably belongs to the genus *Phyllotheca*, but, as a sufficient length of the stem has not been obtained to display the articulation, its precise character cannot be fixed.

VII. & VIII.—*Limestone, Metamorphic and Granitic Rocks.*—Immediately below the Red Shale lie the Marble Beds at Korhádi, which having been dolomitised by the action of heat, no trace of any organised being can be looked for in them. Directly beneath the marble occur various Metamorphic Rocks, disturbed by Granite. Quartz rock is remarkable in the Wein Gangá basin for the rich iron ore which it contains. Kandeshwar, a hill not far from Weiragad, is just a mass of iron ore.

In looking back upon the lowest fossiliferous strata, whose position, in reference to older rocks, we have just indicated, the resemblance in the succession of beds between Southern and Central India is very evident. In both there is the same series of sandstone resting upon shale of various colours, but including green and red, which again is underlaid by limestone and the metamorphic rocks. Though Malcolmson was wrong in inferring the indentity of the sandstone of Central India with that of the Peninsula, from the occurrence of diamonds at Weiragad, which we have seen to have no connection with sandstone there, yet the facts he has supplied in regard to the order of the various strata in the south, when set against

the succession observed around Nagpur, in my opinion fully establish the point. If, then, the sandstone of Nagpur is the far-famed diamond sandstone, it is of importance to inquire into the *mode* and *date* of its formation.

The great abundance of land plants proves that land must have been very near, which would favour the supposition that the water in which the strata were deposited was not that of the ocean. Again, the occurrence of two species of what appears to be *Cyrena*, when taken in connection with the absence of all decided marine shells, would lead us onward to the belief, that the body of water which could have so many land plants floating all over it was not salt but fresh. This conclusion cannot, as it appears to me, be invalidated by the supposition that the freshwater shells may have been carried down into an arm of the sea ; for they are too abundant and entire to have been subjected to such a process. Nothing but the idea that these freshwater shells lived and died on the spot where their bivalves are entombed can, in my opinion, meet the requirements of the case. The freshwater origin of the formation seems to be confirmed by the appearances presented by the littoral deposit of the shale. Though there are reptiles and worms that choose the sea shore for their abode, yet we can more readily conceive the animals, which left their traces so sharp and clear on the ancient mud to have inhabited the banks of an extensive lake. The only objection, of any weight, that can be urged against the view here advocated, is the occurrence of *fucoids* in the Coal Measures of India—a formation which, where it exists, underlies the diamond sandstone. But, perhaps, it is sufficient to reconcile both views to suppose that during the deposition of these strata, though not of the others, the salt-water was let in, and with it a marine vegetation, which was mixed with the land plants that abound in the coal as well as in the sandstone. The marine beds so rich in shells in Cutch seem to be superior to the strata which come under our observation in Central India, and, therefore, are not to be compared with them.

But this brings me, in conclusion, to point out the era at which the Nagpur sandstone was probably formed. I think there are good grounds for believing that it is contemporaneous with the Lower Oolite. The discovery in it of earthworms which are found in that formation ; of seeds analagous to those which occur there ; of *Pecopteris*, *Cyclopteris*, and *Sphenopteris*, which are common to the true Coal Measures and the Lower Oolite ; of *Equisetites*, with its radiated discs, which is peculiar to the latter, and of *Zamites* and *Tæniopteris*, equally

characteristic of the same formation, leaves no doubt in my mind that the most ancient division of the Oolite is that to which our sandstone, and, of course, the coal associated with it, belong; and if my indentification of the Nagpur strata with the diamond sandstone of the peninsula be correct, we may yet look forward to numerous additions to our *Fossil Flora and Fauna*, when the extensive fields of the south are explored with an eye to organic remains.

I cannot close this paper without returning my best thanks to Dr. Leith for the generous manner in which he has supplied me with books bearing on its subject; which I found all the more valuable from their extreme scarcity at an inland station.*

* For "*Xylinosprionites*" p. 68, read "*Xylinoprionites*"

ART. IV.—*The Ancient Iranian Mythology: a Letter to the* Rev. Dr. WILSON, *Honorary President of the Society.* By Professor N. L. WESTERGAARD, of Copenhagen, Honorary Member.

Presented, 21st April, 1853.

*Copenhagen, January 29th,* 1853.

* * * * I send you a specimen of the ancient Iranian mythology, in which I have tried to solve those mystical enigmas, and to represent, according to my views, the ideas and notions which were originally connected with *Yima*, and the other beings of the same class of mortals. My paper was originally written in Danish for my countrymen, and has been translated by a young Englishman, a pupil of mine, and revised by myself.

The most ancient Iranian ideas of *Yima*, and the beings connected with him, belong to that category of mythic tales, which has for its more immediate subject NATURE, the natural powers and effects, man and his destiny. This cycle of mythic ideas, as you know, is represented and painted under the form of corporeal personification, a series of symbolical emblems, which vary in the different mythological systems only according to the way of thinking and to the stage of mental cultivation of the respective nations. What remains of the Zendávesta is no doubt comparatively small, and in many instances very defective; and, therefore, there is much which must remain dark and unintelligible. Meanwhile, the mythology relating to *Yima* is among the clearest, and possesses a peculiar interest, since, as you know, we find here an agreement with the doctrine of the Vedas, which likewise affords us an insight into that altogether ante-historical time, when the Japhetic nations of India and Irán in community began to develope their religious and social existence. To such a time the resemblance in the names must be ascribed, *Yima* being the Iranian, and *Yama* यम the Indian, form of the same word, the original signification of which, however, is not quite clear to me. The same connexion is found in the name of his father, *Vivanghat* and *Vivasvat*, which is to be derived

from the Sanskrit root वस्, to shine and to burn, and *Vivasvat*, accordingly is used as an epithet of several luminous divine personfications, *e.g. Agni, Ushas,* and especially the Sun. In the Zendávesta, *Vivanghat* himself is only mentioned in one passage (*Yaçna* ix. 4, 5) as the first *mortal* who extracted the juice of the sacred *Soma* or *Haoma* plant, and was rewarded, as is said, with the gift of the son *Yima,* who, therefore, in several passages, is mentioned by the names of *Vivangahna* and *Vivanghusa,* the son of *Vivanghat,* just as *Yama* in India was called *Vaivasvata,* the son of *Vivasvat.* With the common origin and original ideas of the mythic tale, (to which I shall return,) with the common father and the common names, the resemblance ceases; and the very ground on which the idea was developed was different in India and Irán. In the former country, *Yama* was referred to the other world—to a spiritual, *immortal* existence, and the abodes of the blessed, whilst in Irán *Yima* was connected with the present life, material existence, and this earth, and was, therefore, like his father, represented as a *mortal* being.

*Yima* is generally called *Khs'aeta,* and *Huvathwa.* The former epithet denotes a ruler, or the glorious one, and is usually also added to the name of the Sun, *Huarekhs'aetá.* The second (*Huvathwa*) signifies having good offspring or progeny. The origin and meaning of this name is clear from the tradition concerning *Yima* found in the first half of Fargard ii. of the Vendidád: there we are informed that Ormazd (*Ahura-mazdá*), called *Yima,* first among all mortals, to be a teacher and bearer of his holy word; but *Yima,* feeling himself unequal to the task, declined the office. Ormazd then calls him to fertilize and extend his worlds, to be their keeper, protector, and ruler. This office *Yima* undertakes, praying that cold and hot winds, sickness and death, may be excluded from his kingdom. He likewise asks Ormazd to teach him the mysterious word, by which he might subdue the hurtful demons. (Such, at least, I suppose the meaning to be of the closing words of the prayer, which evidently have been handed down to us in a very mutilated and fragmentary state, though not at all on that account spurious or interpolated.) Ormazd then presents him with a golden plough, and a gold-formed goad, symbols of agriculture and cattle-breeding. *Yima* now fertilizes the earth; or, according to the expression used in the Vendidád, *Yima* is in woman's womb; and after 300 winters (*zimo,* not *zemo,* countries,) have elapsed, the earth is thereby filled with living beings, ("large and small cattle, men, dogs and birds",) and likewise with red, shining, flames; and there is now no room for the living to move. At the command of Ormazd, *Yima* rises, to use the original expression, "towards the light, at midday, opposite

the path of the sun ;" consequently, when the day was shining in its brightest splendour. He furrowed the earth with his plough and pierced it with the goad ; and in answer to his prayer to the earth, the latter expanded, and became larger by one-third its former size, so that there was now room for every one to move according to his will and inclination. When 600 winters had elapsed, the earth was again filled, and again *Yima* caused it to expand to the extent of two-thirds its former size, but after 900 winters the earth again was filled, and *Yima* by his prayer extended the earth for the third time, so that it became larger by three-thirds its former size ; and again there was room for all to move according to their will and inclination. The vast extent of the earth was thus, according to the idea of the Iranians, essentially attributed to the exertions of *Yima*. He fertilised the extended earth by agriculture and cattle-breeding, and filled it with living creatures. But he likewise—and this was his peculiar and permanent office—took especial care of the creature's welfare, and he obtained, by his prayers, from Ormazd and other divine beings, the power necessary to the fulfilment of this office. The general manner in which the activity of mythical beings is represented in the *Yashts*, (the chief source of Zend mythology,) is the form of a prayer. They are represented as asking different divinities for power to do what is of importance for them. The prayers of the good are then answered, but those of the bad rejected. The doings of *Yima* are, therefore, thus described :—" Let me bestow fecundity and posterity ; let me confer immortality on the creatures of Mazdá ; let me drive away from them hunger and thirst, old age and death, the cold and the hot wind, for a thousand years." (*Gosh Yasht*, 9, and *Ashi Yasht*, 29.) "Let me obtain supreme power over all people, demons and mortals, magicians and fairies, and the hostile beings that cause deafness and blindness : let me deprive the demons of their glory and happiness, their offspring and fecundity, their contentment and renown." (*Abán Yasht*, 25.) " *Yima* is the brightest (or happiest) of those that are born ; he is like the sun amongst mortals ; by his power be obtained for men and cattle freedom from death ; he prevented water from being dried up and trees from withering, that they (the creatures, beings) might eat food not to be diminished. By his might there was neither cold nor heat, neither old age nor death, nor envy created by the demons." (*Yaçna* ix. *Rám Yasht* 15.) As long, then, according to the ideas of the Iranians, as *Yima* reigned, and this was for the space of a thousand years, neither hot nor cold winds did blow ; neither heat nor cold was experienced. The seasons, consequently, were constantly mild and pleasant : men were exempt for all bodily wants ; not suffering from

hunger and thirst, because the food never diminished, as the water never dried up, nor the fruit-trees withered. Not only did *Yima* bestow fecundity on living creatures, and bless them with posterity, but they were also exempt from the consuming effects of time—*Yima* having brought immortality to them, so that they never grew old, but perpetual youth prevailed, and, as we read, "father and son both came forward as youths of fifteen in growth." (*Yaçna* ix.) There was therefore no sickness nor death; men and beasts were immortal under the reign of *Yima*. At that time, accordingly, men were blessed with all the kindly gifts of nature, and lived, besides, in peace and love with all around them; envy and hatred, created by the demons, not having as yet insinuated themselves into their hearts. *Yima* had, moreover, power over the demons, and did deprive these of the power of hurting, as well as of the contentment and happiness which had fallen to the lot of earthly beings.

As *Yima* was born of a bright and luminous father, so his abode was likewise connected with light. The mountain *Hukairya* (beautiful in shape), which is likewise called the all-beaming, the golden, was the place whence his efforts in behalf of mankind proceeded. It was the highest summit of the lofty mountain *Haraiti* or *Hara*, (or, to use the later name, *Alburz*, that mythical mountain of the east, which formed the boundary between the transitory and the eternal world, and was the place whence *Mithra*, the genius of light, illuminated the whole world, and where, therefore, neither night nor darkness was to be found.

From these mythic tales about *Yima*, I think, we may perceive the idea originally connected with him; and Professor R. Roth, at Tübingen, has already a few years ago considered *Yima* as the symbolical representation of the golden age, with all the blessings of abundance and peace. To this I shall only add, that *Yima* certainly is the symbolical representation of the golden age, or (as every man has his golden age, however short it may be) the symbolical emblem of the happiest time of man, the brightest state of life, but only as far as this depends on the earthly or material well-being, furnished by the physical blessings of nature; because *Yima*, being, as we may remember, unable to bestow on men the holy word, or knowledge of God, he could not be the symbolical expression of that happiness which is unattainable without that knowledge. The same original idea was, in my opinion, connected by the Indians with their *Yama*: he, too, likewise, was a symbolical representation of the golden age, an emblem of the happiest and brightest state of man. But, though the Hindu embraced life and its blessings

with as much loving attachment as all other earthly creatures, he was less ensnared by its pleasures; for his depth of thought, and serious disposition of mind, led him to form a more correct estimate of the transitory nature of earthly enjoyment. His attention was, therefore, turned to the life beyond death: it was there he sought for, and there first he found his real home. The kingdom of the dead was, consequently, in his eyes, not a dreary abode of pale and gloomy spirits, deprived of all enjoyment and pleasures; but (as was also the case in the Scandinavian mythology) endowed and provided with all that was fairest and most glorious—a place at which it was joy to arrive. There, and there only, he found the real golden age; and *Yama*, consequently, reigned in India *immortal* in the land of the blessed. The Iranian, on the other side, looked more at the present world. His ideas of *Yima* and the golden age became then naturally connected with this earth and the present life. This *Yima* was, therefore, a *mortal* being, living only in, and for the sake of the transitory world; and, consequently, perishable with it. Though in the mythology connected with a particular time he was not only the symbolical representation of a vanished golden age, never to return, but also, in general, (as hinted at above,) the symbolical emblem of every man's happiest material condition; and when, for instance, the day in its brightest splendour revealed all the glory of nature,—when genial seasons produced an abundance of all the gifts and blessings of earth,—when man lived in his fullest vigour, at peace with himself, and in love with all around him—*Yima* was still beheld reigning on earth, and spreading his blessings around him; and therefore it is said in the Farvardin Yasht—"We must worship the prototype (*fravashi*, feroher,) of *Yima*, the son of *Vivanghat*, the true and powerful, having good offspring ... to avert the evil caused by demons, the drought destroying the fields, and the consuming decay."

This bright and happy state, of which *Yima* is the symbolical emblem, was, however, perceived by the ancient Iranians to be of a transitory nature. He sought for the reason of the interruption or suspension of his happiness, and found it in man himself—in *Yima*'s own transgression. The tradition respecting this is found in the so-called Zemyád Yasht, which, having stated the doings of *Yima* in the same manner as the other sources, adds that this bright condition or happiness, *Khareno*, attended *Yima* because his affections were free from evil, and continued until lying and falsehood entered his mind. This was the reason assigned by the Iranians for the loss of happiness, and lying was held in general abomination, not only in those countries in Northern Irán (Bactria, &c.)

which furnished the origin of the Zendávesta, but to an equally predominant degree in Western Irán. The assertion of Herodotus is well known, that the Persians taught their sons but three things—to ride on horseback, to draw the bow, and to speak the truth; and Darius, the son of Hystaspes, in one of his inscriptions, asks Ormazd to protect his kingdom from three evils—hostile invasion, sterility or failure of crops, and falsehood. "When *Yima*," continues the Zemyád Yasht, "had admitted lying and falsehood into his mind, bright happiness departed visibly from him in the shape of a bird, and *Yima*, not perceiving any more the happiness to shine, sorrowed and stooped down to the earth." Three times, as the Yasht informs us, happiness did fly away from *Yima*, but not to him was it given to recover the vanished bliss. *Yima*, being the personification of happiness whilst it exists, he must disappear when it ceases, and to contend with misfortune, to arrest the flight of happiness and return it to man, other powers, other mythic beings (*Mithra, Thraetaona, Keresáspa,*) are required.

The first time, consequently, that happiness flies away from *Yima*, it is seized by *Mithra*, whom Ormazd made the brightest and happiest amongst holy spirits, as *Yima* is amongst mortal beings. *Mithra* is the kind and friendly Lord of Light: he is not, as *Yima*, a mortal being, but a spiritual and immortal one, because the light is not confined to this perishable world only, but, radiating without beginning, it shines also with Ormazd, and in his eternal world. The fleeting happiness which, according to the mythic tale, is seized and arrested by *Mithra*, is, therefore, undoubtedly the bright splendour of day, shrinking before the gloomy darkness of night. But *Mithra* lightens the night with his countless host of stars; he chases the darkness with his light, and restores to *Yima* and the earth the bright felicity of day.

The second time that happiness departs from *Yima*, it is caught by *Thraetaona*. He belongs to the powerful race of *Athwya*, being a son of *Athwya* himself. Like the father of *Yima*, *Athwya* was a mortal being, but all that we learn respecting him from the Zendávesta is, that he was the second mortal who extracted the juice of the sacred *Haoma* plant, and was rewarded for this by the gift of the son, *Thraetaona*. The name of *Athwya*, which in this form cannot be explained, has long ago been shown by Burnouf (alas! too early removed, by untimely death, for the sciences) to be the Sanskrit *Á'ptya* (आप्त्य) whence it is derived by metathesis of the two middle consonants *pt*, and the consequent necessary change of *tp* to *thw*. Both forms occur in the later Persian development of this mythic tale, in which the father of *Thraetaona*, or, as he there is called, *Feridun*, is mentioned commonly under the name of

*Atbin*, more consonant to the Zend, whilst in Ferdausi we find the more Indian like form *Abtín*. The Indian *Áptya* denotes one sprung from the waters, whether flowing on the earth or floating in the firmament. This name is applied in the Vedas to *Trita*, an aerial divinity, and the name of *Thrita* is likewise found in the Zendávesta, but is there attached to an entirely different being or beings, to whom I shall return. There is, however, such an agreement between the doings of the Indian *Trita* and the Iranian *Thraetaona*, that the common origin of the mythic tale is evident, whilst it has been differently developed in the two countries; on which account the part assigned to the Indian *Trita* has become a more subordinate one than that of the Iranian *Thraetaona*. The latter is said to have been born in the four-cornered *Varena*, mentioned in the list of the Vendidád (Fargard i.) as the fourteenth land created by Ormazd. If this be an earthly land, which I doubt, it must be sought for in the neighbourhood of the west of India, as that country is mentioned as the fifteenth in the catalogue. Meanwhile the land of *Varena* is only mentioned in the Zendávesta in connexion with *Thraetaona*: there he was born, and thence his prayers ascend to the heavenly powers. The *Varena* denotes that which defends, hinders, or bounds in; and as the epithet four-cornered no doubt alluded to the four corners of the world, and as *Thraetaona* is in reality no human king, but an aerial being, *Varena* seems to denote the extreme and remote regions of the sky, which, as it were, divides heaven from earth, and forms the boundary of the view. The Zend word *Varena* corresponds farther in its etymology on the one side to the Greek οὐρανός, heaven, and on the other to the Indian *Váruna*, वरुण, the God originally presiding over the remotest bounds of heaven, (where sea and sky, as it were, melt together,) and who generally in the Vedas is represented as the mythical lord of evening and night, but in the later mythology as the god of the sea only. The Iranian *Varena* may possibly, as a counterpart to the abode of *Yima* on the extreme mountain of the east, principally denote the extreme western limits of the firmament, which every evening conceal the sun and the light, which would account for the adjective *Varenya*, formed from *Varena*, being in the Zendávesta only applied to malign spirits.

The chief exploit of *Thraetaona*, which is often related, but nearly in the same words, was his fight with *Azhi Dahâka*, the destructive serpent. This serpent is described as having three heads, and consequently three mouths and six eyes, and possessing a thousand powers: he was of malevolent disposition, and by far the most vigorous of all evil beings, created by the evil spirit *Ahriman* for the destruction of the worlds of

truth and goodness. This destructive serpent is represented in the Yashts Abán and Rám as requesting the mythical beings *Ardvisura* and *Vayu* for strength to dispeople all the countries of the earth. His request is of course rejected, and on the contrary both these two and other good spirits confer on *Thraetaona* power to subdue the serpent, together with its zealous and mighty brood. Now, as *Thraetaona* combats the serpent *Azhi*, the Indian *Trita* also fights with a serpent अहि; and from this resemblance we learn the import of the Iranian mythos. The Indian अहि as well as the Zend *Azhi* (two forms of the same word) denotes a serpent; but as in the East the serpent was the symbol of both moral and physical evil, the word denoting serpent was likewise in India applied to the huge masses of thick and heavy clouds, which during the rains conceal the heaven, and seem to threaten the earth with destruction. At such times *Indra* hastened to the combat; he scattered the clouds with his lightning, and chased them from the sky, slaying *Azhi* or the cloud-serpent, in which combat he was assisted by *Trita* and the divinities of the winds. The same physical and natural representation I find in the Iranian mythos of the combat between *Thraetaona* and the serpent. *Azhi Dahâka*, too, is no doubt the same malign cloud-serpent; and this is the reason why he especially addresses his request to *Ardvisura* and *Vayu*, being in fact somewhat related to these beings, who may be briefly said to be personifications of water and wind. (To *Ardvisura* I shall have occasion to return.) *Indra* was a *deva* in Irán as well as in India, but, as is well known, the signification of this word *deva* was quite opposite in these two countries, the bright *deva* of India being in Irán an appellation of evil demons, among which *Indra* is reckoned. *Thraetaona*, therefore, could not, like the Indian *Trita*, be an auxiliary of *Indra*; but he performs himself the part of *Indra* in the combat with the cloud-serpent. *Thraetaona* is consequently an aerial being, sprung from the waters of the firmament, and born in the extreme regions of the sky: he is not a *god*, as *Indra*, the lord of bright heavens, but a *mortal* being,—a child of nature and the material world,—and, therefore, perishable, like his parents. The resemblance between *Indra* and *Thraetaona*, indicating consequently the common origin of the mythic idea, is confirmed by a common epithet, which meanwhile can only be rightly explained by the help of the Indian mythology. The huge masses of clouds, personified under the shape of a serpent, are here likewise called *Vritra* (वृत्र) the hiding, hindering one, and *Indra* slaying *Azhi* or *Vritra* is consequently styled (वृत्रहन्) *Vritra* slayer. The same epithet (*Verethrajan*) is applied to *Thraetaona*, and dates evidently from the time when the Iranians lived

in peaceful union with India, as the Iranian *Verethra* has lost that peculiar sense of the Indian वृत्र, (which is only preserved in *Verethrajan*, and the derivative noun *Verethragna*,) and has adopted a general meaning of victory, or power of resistance; and by this reason, the word has become synonymous with *Verethravat*, he that is endowed with power of resistance, or the victorious; an epithet likewise applied to *Thraetaona*, who is said in the Zemyád Yasht to be the most victorious of all victorious mortals next to Zoroaster. He, too, had to sustain a combat, but against moral evil, whilst the efforts of *Thraetaona* were directed against physical evil in general, which is caused by those natural powers of the air and sky above the surface of the earth; for his efforts were not confined to the combat with *Azhi*. We are likewise told in the Farvardin Yasht that his prototype is to be worshipped to avert sickness caused by extreme heat, to avert excessive rains and inundations, as well as the injury produced by *Azhi*. The mythos of *Thraetaona* is thus founded merely on an incorrect and imperfect though poetical view of nature. He is the symbol or image of those beneficent powers of the air, the efforts of which, it was imagined, were directed against the violence of the hostile and malign influence, to hinder the injury threatened by the latter to the earth. When, therefore, the bright happiness flies away from *Yima*, on account of his guilt,—when the face of heaven is darkened, and the sky covered by black clouds,—when inclement seasons, with all their attendant trouble, exercise a pernicious influence on the physical welfare of man,—when thus all in nature is dark and displeasing—then *Thraetaona* is called into action, and seeks to remedy the evil: he, therefore, is seizing the happiness flying away from *Yima*. With this idea of *Thraetaona* as a kindly aerial being, beneficently disposed towards the earth, another mythic tale concerning him agrees, if I correctly understand its import. This tale is found in the Abán Yasht, and its contents are briefly as follow :—"The first *Vafra Navúza* worshipped *Ardvisura*. When pursed on high by *Thraetaona* in the shape of the bird *Kahrkúsa*, for three days and nights he tried to descend towards his own habitation, but could not get any farther; thereupon he prayed to *Ardvisura*, promising her a thousand offerings at the waters of *Rangha*, if he were enabled to reach his own habitation and the earth : she then appeared in the form of a lovely maiden and fulfilled his request." Now *Ardvisura* is the personification of all the natural fluids, the effects of which are refreshing, animating, fertilizing—*e.g.* the fluids that are in the waters of the earth, and in the rains of the sky, in the prolific strength of man, in the womb of woman, and the milk in her breasts, etc. The signification of *Vafra* is not yet quite

clear to me, although it seems with a high degree of probability to be the Persian *barf*, (برف) snow.

If so, *vafra navâza* denotes the newly fallen snow, and the idea of the mythos would be—The snow leads down towards the earth, its resting place, and consequently its proper habitation; but as its end might be noxious and injurious to the physical welfare of man, *Thraetaona* seeks to retain it in his dwelling on high. Yet the snow is in fact a part of the real essence of *Ardvisura*, and not, like the destructive cloud-serpent, *Azhi*, altogether evil, without utility. According to its prayer, it is permitted to reach the earth, where its moisture in return exercises a somewhat beneficial influence; for a slight fall of snow could not be regarded as a positive evil in countries, like Irán, which have always suffered from drought and want of water.

The third time bright happiness flies away from *Yima*, it is seized by *Keresâspa*. He belongs to the family of *Sáma*, of which besides his brother *Urvákhshaya*, and their father *Thrita*, are mentioned. The name of the family, *Sáma*, denotes the bringer of rest, the quieter, calmer or soother, being allied to the Sanskrit root शम् ; and this single word indicates the aim of all the efforts of the family in their different directions. As the object of these efforts was mortal man,—as they were intended to promote his well-being, and therefore to cease on his death,—the whole family of *Sáma* must be *mortal*, like man with whom it is connected. Of this family, the Yaçna (chap. ix.) tells us *Thrita* was the most useful: he was the third mortal, next to *Vivanghat* and *Athwya* who extracted the juice of the sacred *Haoma* plant, and was rewarded by the gifts of his two sons. As to the utility of *Thrita*, and the tendency of his efforts, we are directly informed in the Vendidád (farg. xx.) that he was the first of the persevering, bright vigorous mortals, who brought disease to disease, and death to death, and averted burning fever from the body of man. *Thrita*, thus, so to speak, renders disease itself ill and weak; he breaks its power, arrests the attack of death, and removed the pains of the body, for which purposes he is provided with remedies by Ormazd himself. *Thrita*, however, is not of course to be considered as an actual human physician, but as a symbolical emblem or personification of the healing, restoring powers of nature. For this reason he is considered as belonging to the family of *Sáma*, as he soothes and calms the pains and diseases of the body: he is a *mortal* being, like the body with which he was connected. But he was looked upon as the most useful of the whole family, no doubt because man in his infancy, devoid of scientific experience, felt himself in this particular least capable to render any ser-

vice by himself, but entirely obliged to rely on the healing powers of the enduring and indefatigable nature, or, to use the words of the mythic tale, on the healing power of *Thrita*. His name is identical with the above-mentioned Indian *Trita* (त्रित) ; and the Sanskrit translation of the Yaçna adds, that he was so called because he was a third son (यत्पुत्रः ततीयो बभूव) ; and in this case the name must be derived from the numeral *Tri* (त्रि), as we find in the Vedas, or *Dvita* and an *Ekata* (from द्वि and एक), mentioned in connexion with *Trita*.* But I am more inclined to seek the etymology of the Zend *Thrita* in the root *Thrá* (Sanskrit त्रै and त्रा), to save or preserve, in which case the name would be significative of his office. He is not the only *Thrita* mentioned in the Zendávesta. In the Abán Yasht mention is made of *Thrita* and *Ashavazdah*, sons of *Sayuzhdri;* but as these are named in connexion with the war against the hostile nomadic tribes, they seem rather to belong to the ancient traditional history of Irán than to its mythology. This *Thrita* is also mentioned in the Farvardin Yasht, together with a female *Thrita* or *Thriti*, amongst those whose prototypes are to be held sacred; but this is also the case with other persons, who apparently belong to the traditional history only (*e.g.* all the Káyanian kings).

The first son of the mythical *Thrita* was *Urvákhshaya*, whose name denotes the wide-ruling or wide-protecting one. He is said in the Yaçna to be pious, and an extender of justice ; and in the Afrín Zertusht it is said—"Be beneficent and open-hearted like *Urvákhshaya*." Though no further particulars are given as to his nature, this is sufficient to point out the idea connected with him ; and we shall, I believe, hardly err in regarding *Urvákhshaya* as the symbolical image of man's eternal power, and the beneficial effects of time in soothing sorrows and calming passions—as the image of the kindly feelings of man, that incline him to be just and benevolent to those around him. That is the reason why *Urvákhshaya* is represented as a scion of the *soothing* family of *Sáma*, and a son of the *healing Thrita*, because he relieves the diseases of the mind, as his father those of the body. He is mortal, because his function terminates with the life of man ; there being in yonder world neither grief nor passion, neither malevolence nor injustice. But here on earth he is wide-ruling or wide-protecting, since every man needs his assistance. Inward action like his, and the quiet, peaceful life, which is its consequence, do not afford much matter for outward report, and hence it is quite natural that *Urvákhshaya* is so seldom mentioned. But a kindly and peaceful character is also exposed to attacks and injuries from others, being often without the power of resist-

* Mahábharata, iii. 2783.

ing and the wish of avenging them. To this refers another mythos, (to which I shall presently return), in which *Keresáspa*, the brother of *Urvákhshaya* is made to say—"Let me proceed to avenge my brother *Urvákhshaya*; let me slay *Hitáspa*."

The third person of the family of *Sáma*, *Keresáspa*, appears under a more distinct form. He is young, with a tall body and a manly disposition: he is armed with a spear and a club. Next to Zoroaster he is the strongest of the strong mortals, on account of his courage in meeting dangers. He is a warrior in all his might and strength, and this also is implied in the name *Keresáspa*, which signifies one whose horses are lean, and therefore swifter and more enduring, which is still the case on the plains of Turkistan. But though a warrior, he is not a savage, furious, barbarian, as he belongs to the *soothing* family of *Sáma*, is a son of the *healing Thrita*, and brother of the *pious Urvákhshaya*. His calling and function is, indeed, war; but he does not pursue war for the sake of war, but only to heal the wounds of discord, to remedy the breaches of peace, and to restore vanished tranquillity; and the holy prototypes of the good protect his body, the strength of which is required in fulfilling his calling. He must, accordingly, be considered as a symbolical emblem or personification of the brave courage and bodily strength of man, not attacking but in self-defence, though armed and ready for the fight whenever and wherever danger presents itself. With this agrees what is also said in the Farvardin Yasht:—"We worship his prototype to avert hostile violence; and the invading host, to avert the evil man, and the injury caused by the evil." *Keresáspa* is a mortal being, constituting a part of the nature of man: he is the strongest of all mortals, but inferior to Zoroaster, because the combat sustained by the latter, being for the faith and the spiritual life, was of higher import, and consequently required a greater strength than the contests of *Keresáspa* for mortal life and temporal repose. As his calling is war with the living foes of man, his doings were of a clearer and more distinct nature than those of his two kinsmen; and this seems to be the reason why he alone exclusively is mentioned in the mythic tale as seizing the bright happiness the third time it flies away from *Yima*; this flight of happiness having evidently a general reference to all the distress and sufferings which have their origin in man himself, and in the injuries of the living around him; and, indeed, to remedy this, the aid and assistance of the brother and father is as such needed; but their efforts, being more indoor, of a more concealed nature,—more directed to the internal state of mind, and domestic, homely, life,—are not so much matter of outward

report and renown as those of *Keresáspa*, who, fighting out of doors, strives to restore the disturbed peace.

Many and various being the causes of the disturbance of peace, many tales are found concerning *Keresáspa*. These all relate to his warfare; but being in general very briefly told, and often only lightly touched upon, the import of these mythic tales is darker and less clear than might otherwise have been the case. The description of external circumstances in the mythic tales, as is well known, is taken from actual life, and may, therefore, very well contain a reference to real facts (though now unknown to us), and be adorned with real traits of character, and names devoid of all mythological signification; which additional matter must necessarily first be sifted before we can arrive at the original idea and real essence of the mythic tale. This is particularly likely to be the case with those mythic tales, the subject of which is man himself and his doings. Although there is, therefore, every probability that in the foes subdued by *Keresáspa* we have personifications of the different physical and moral causes that tend to disturb our external peace and tranquillity, it is not yet clear to which of these causes each particular tale alludes, especially when this is but only slightly touched upon, or merely the name of a foe is mentioned. I shall, therefore, at the present confine myself to those mythic tales which contain somewhat more matter than a mere name.

The chief exploit of *Keresáspa*,—being at least the only one mentioned in the Yaçna, and the first recorded in the Zemyád Yasht,—is his fight with the venomous serpent or adder *Sravara*, (*i. e.* having horns or claws,) "which devours men and horses, on whom the green venom did flow with the thickness of an inch." The idea of the mythos seems evident, and the adder undoubtedly signifies all the wild beasts, dangerous for the peace and safety of man, whose attacks and injuries often oblige him to take up arms and defend himself. The serpent seems to be expressly named only as being an emblem of all evil, and, as the Bible says, more subtle (consequently more dangerous) than all the beasts of the field. But as to the particulars of this mythic tale, I am still in the dark, nor do I know to what it alludes when it is further said "*Keresáspa* slew the adder, and was cooking it to food in an iron-pot: at noon it began to burn, and hissed, leapt out of the pot, and overturned the water to flow: away turned the valiant *Keresáspa* frightened."

I have mentioned above the tale about *Hitáspa*, whom *Keresáspa* slew to avenge his brother *Urvákhshaya*. No further particulars are given respecting *Hitáspa*. The very etymology of his name is uncertain; but to conclude from the manner in which he is mentioned, he

must apparently be the representation of the bitterest foe of a pious and peaceful life. His name *may* mean "he with the *pale* horses." Perhaps, then, he might have been intended to represent pale envy and cunning malice, that grieve at the happiness of others, and are only solicitous to disturb it for the sake of their own profit, or even for no purpose at all but that of disturbing it.

Another vanquished foe is *Zaripâshna*, "who rushes forth with extended jaws" to destroy the material world of truth—or purity. The name denotes "he with *golden* heels." May we not, therefore, look upon him as the personification of the '*auri sacra fames*,' the impure spirit of covetous greediness, which cannot find rest or tranquillity in the possession of what it has, but always covets and desires more—even that which can only "by fraud and violence be obtained." He belongs —which meanwhile does not throw further light on the idea of the mythos—to a class of beings called *Gandarbas*, which in India are considered as attendants in the heaven of *Indra*, but in Irán, like *Indra* himself, have become evil beings.

Amongst other foes subdued by *Keresâspa*, but whose names merely are given, without any further description, we find in the Zemyâd Yasht one *Snâvidaka*, "who strikes with his claws." Though the etymology of the name is uncertain, he is clearly painted as a haughty, though impotent spirit, of vain pride and wild ambition, with far roaming desires, who, merely for the sake of his own amusement or gratification, wishes even to turn the whole earth upside down. Thus he is introduced speaking: "I am but feeble; were I powerful enough, I would make the heaven my chariot, and the earth its wheel: I would bring down the holy spirit from his bright mansion on high, and raise up the evil spirit from his dark abode of misery. They should then both together draw my chariot, unless *Keresâspa* kills me." But, the mythos adds, he was slain by the valiant *Keresâspa*.

*Keresâspa* seems also to have been placed in a friendly connexion with one of the fairies, who elsewhere are represented as evil beings. We read thus in the Vendidâd (Farg. i.) concerning the desert of *Durhaka*, the seventh place created by Ormazd:—"There the evil spirit produced a fairy, whom she crushed, who followed *Keresâspa*." (*Ya upanghajat Keresâspem.*) According to the words of this passage, the subduer of the fairy must have been a fairy herself; but this passage may possibly contain merely an allusion to the nature of *Keresâspa*, at that time of course generally understood. At least the clause is found literally in another passage (in the *Zemyâd Yasht*) applied to manly courage, the inseparable companion of a hero, and surely as much required in the combat against the fairies and spirits of darkness.

The doings of *Keresáspa* are of course extended over the whole earth; on earth, consequently, his native land and his home must be sought for. Therefore, as *Yima* proceeded from the highest summit of the bright mountain of the east; as *Thraetaona* was born in the remote regions of the sky;—so *Keresáspa* is connected with the sea of great gulfs, the earth-surrounding ocean, *(Rangha,)* from which place he, like the ocean, might embrace the whole earth.

These natural fables, which I have severally examined,—these mythological representations of the condition and movements of nature and mankind,—assumed, in the course of time, a more sensible, bodily, and human shape; and thus *Jemshid, Feridun, Gershásp* merely appear as purely human kings and earthly heroes in the later traditional history of Persia. I shall not, however, enter on this development of these mythic tales and ideas, but seek to unite them in a whole; for they really combine to compose one idea, being the several parts of one image, under which the ancient Iranians, twenty-five centuries or more ago, tried to represent their views of the earthly happiness and physical welfare of man, of the contending powers of nature contributive to, or destructive of this happiness, and of the combat necessary to secure it and restore it when lost by man's own transgression.

The bright *Yima* dispenses earthly happiness, which reigns, as long as he is free from guilt, abundantly and undisturbed on earth amongst all creatures, but vanishes on his transgression, he having no power to retain or restore it. The light of day is chased by the gloomy darkness of night, but the kind lord of light seizes the flying happiness. Nature loses its bright and cheerful appearance,—the face of heaven becomes covered with black, threatening clouds,—dark and inclement seasons suspend and destroy the kindly gifts of nature. Then *Thraetaona* is born in the extreme regions of the sky: in the very quarter whence the misfortune proceeds, he combats and dissipates these impediments of nature and the firmament—the combat against these being his office and vocation. Hinderance to happiness further arises in man himself, and is occasioned by him, but this the family of *Sáma* seeks to remove. When sickness attacks the human body, and destroys the enjoyment of life, *Thrita* appears with his healing influences. When sorrow oppresses the hearth, and passion rages in the breast,—when they spread gloom over the mind, and disturb its peace,—the calming, tranquillising *Urvákhshaya* hastens to its assistance, and he restores the peace of mind, and, like his father, enables man again to enjoy the blessings of life with pleasure and cheerfulness. In the hour of danger, when the malice, avarice, or enmity of others threaten to disturb the temporal peace of man, and wild beasts endanger

his safety, then *Keresáspa* steps forth, armed and ready for the fight: he valiantly subdues the foes, avenges the offences, and removes every danger. In short, *Yima* diffuses earthly happiness; and the other beings combat and remove, according to their several offices, the obstacles which stand in the way of happiness; and, with the exception of *Mithra*, the lord of light, they are all mortal: their activity, being confined to this perishable world only, must terminate with that with which it is connected—when their assistance is no more required, they can no more exist.

Here the Zemyád Yasht closes its allegory of the happiness of man on earth, of its interruption and cessation, and of the combat necessary to restore it. But the allegory is not complete. Even when earthly happiness beams in all its splendour and abundance; even when man, in full vigour of body and tranquillity of mind, is able without disturbance to enjoy the rich blessings of life: even then his happiness is not complete—something is wanting still; and that the ancient inhabitants of Irán did well perceive,—that, namely, which *Yima* was unable to confer on man,—knowledge of God and his holy word. The Haoma Yasht (included in the *Yaçna*, chaps. ix. x.) completes the allegory. This Yasht first mentions *Yima*, the dispenser of earthly happiness; then *Thraetaona* and the family of *Sáma*, who remove the obstacles to this happiness; and lastly, in the fourth place, it speaks of *Zoroaster*, whom Ormazd had given to complete the happiness of man, by bringing to him that knowledge he was still wanting. *Zoroaster* is mentioned last; not, however, because this subject appeared light or unimportant to the ancient Iranians: on the contrary, it was also in their estimation the highest and most important of all; and therefore they believed *Zoroaster* to be the most victorious and vigorous of all mortal beings, and they believed it to have been the first and chief desire of Ormazd, in his love to man, to bestow upon him this knowledge, and the happiness unattainable by any other means. But the Iranians likewise perceived that the worldly man, absorbed in or ensnared by worldly enjoyment, is but too apt in his happiness to forget his Creator, (and this view is indicated by *Yima* feeling himself incapable to be the bearer of the faith,) and they saw how often distress and trouble were the only means to force the man to turn his mind to God. This is no doubt the reason why *Zoroaster* is mentioned last: he is, however, of a different nature from the other beings I have mentioned, and is only connected with them is as far as he serves to complete the allegory I have been trying to explain.

There is yet one mythic tale concerning *Yima* which does not not, however, belong to the allegorical image and ideas of earthly bliss

treated of above, and which I shall here merely touch upon, being at present not prepared to trace out the whole extent of the ideas which apparently are indicated in this mythic tale. This occupied the latter half of the second fargard of the Vendidád, following immediately after the mythic tale, mentioned above, concerning the doings of *Yima*, in the way of extending and fertilising the earth; but the introductory lines of this tale, forming the point of connexion with the preceding one, are unfortunately come down to us in a very defective and consequently obscure state, from which we may meanwhile gather that the period of the tale was thought to be subsequent to the millennium of *Yima*. The contents of the mythic tale are briefly as follows:—Ormazd meets with the holy spirits, and *Yima* with the best of the mortals; both renowned in the Arian land of the source of the good Dáitya—*Airyéné vaêjahi vanghuyáo Dáityayáo*. (*Dáitya* is the name of a river, I suppose the Oxus.) Ormazd then reveals to *Yima* that all countries throughout the whole material world are to suffer from severe freezing winters, and afterwards from sudden thaws, inundations, and heavy rains. As Ormazd commands, *Yima* then plants a square garden, enclosed by a fence; he conveys thither germs of living beings, ("of small and large cattle, men, dogs, and birds,") and of the red shining flames; he adapts the garden for an abode for man and pasture for cattle, and causes the water to flow abundantly; he conveys thither the largest, best, and most excellent *germs* of men and women, and of every kind of cattle, the largest and most fragrant germs of all trees, and the best flavoured germs of meats; this was done by pairs, and not to perish as long as man remained in the garden. There was no slander nor reproach, no strife nor enmity, neither arrogance, deceit, wretchedness, nor insidiousness; there was not to be found any deformity of body, nor any of the evil marks with which *Ahriman* does mark the man. A further description follows, concerning the arrangement of the garden, and the distribution of the human beings, which description is very obscure, and not altogether intelligible to me. Although this mythic tale is given at great length and with detailed description, it is nevertheless not clearly stated where the place of the garden was supposed to be situated—either on earth or in heaven. Is the garden to be found on earth, and in this present state of the earth? But the life in the garden is far different from the earthly one. The light shines there continually—the sun, moon, and stars appearing together; a year here is there but one day; after forty years (not as else forty weeks) one pair, son and daughter, is born of two human beings; and thus, likewise, amongst all kinds of animals, man does live there the happiest life. Besides, it is not *Zoroaster* who teaches there the faith of

*Mazdá*, but another (the name of whom is somewhat dubious, as the spelling of the manuscripts differs in this the only passage where it occurs: he is at least certainly no *bird* at all). Besides, *Zoroaster* is considered to be everywhere else the chief spiritual lord and teacher (गुरु); but although he exercises likewise these functions in the garden of *Yima*, he is not alone in the office, but only second to *Urvatat-nara*, who in the two other places where he is mentioned in the Farvardin Yasht is called the *later born*, the Zoroastrian, or son of *Zoroaster*. Or were it believed that the garden was placed in yonder world, does it give an image of the felicity of the just in the life beyond death? But the souls of the just are conveyed elsewhere, beyond the lofty *Hara*, to the immortal world, where Ormazd and his holy spirits dwell. (*Vendidád*, Fargard xix.) The *souls* of the just themselves come thither, and not the best germs, whence *material* beings may be developed; beside, they no doubt carry along with them the faith, by means of which they go thither, and they do scarcely in yonder world require a new prophet, especially as Ormazd himself is the teacher and master (गुरु) of the whole spiritual world. (*Vespered*, k. ii.) Either of these two suppositions respecting the situation of the garden seems equally opposed to what is elsewhere expressly stated. But taking the actual words of the mythic tale, the import of which is that *Yima* carried to the garden the best *germs* of men and beasts, (and not the creatures themselves,) and that life there is for the most part of an earthly nature, (for living beings are born there,) though in a purer and superior shape, it appears to me that the thought leads to the idea, so finely developed in our Scandinavian mythology, of the *renewal* of the earth in a far better and nobler form after the destruction of this present one, and of the ancient divinities. A similar idea appears to be the foundation of this mythic tale about the garden of *Yima*: it seems to refer to a notion of a future and better state of earth, in which more perfect beings will sprout up from the best germs, preserved thither from this state of earth, and in which *Yima* will reign, as on the present earth, as a symbol of material happiness (for he is not even there to be the bearer of the faith), but in which, being undisturbed by earthly impediments, he will not, as at present, require the aid and assistance of other beings similar to *Thraetaona*, and the family of *Sáma*.

This is what I have read and found in the ancient tales of the *Zendá-vesta*; and I am sure that you at least will read this sketch without being tired, and with the same good feeling and benevolence towards me of which I have already received so many proofs.

# ART. V.—*Brief Notices of Persian, and of the Language called Zend.* By JOHN ROMER, Esq., M.R.A.S., formerly President of the Society. Communicated by the Rev. Dr. WILSON, Honorary President.

Presented, January 20th, 1853.

[*Extract from the Proceedings of the Society, 20th January*, 1853.

Dr. Wilson, in directing attention to this paper, which had been forwarded to him for presentation to the Society by Mr. Romer, formerly President of the Society, remarked, that the languages connected with Irán, genuine and spurious, to which attention of late years had been directed, are the *Zend*, in which the books esteemed sacred by the Pársís are found, and which by some, though not by our best British linguists, had long been held to be the parent of the modern Persian; the language in which the Achæmenian inscriptions at Besitun and other places are composed, which is now correctly denominated by the German philologists the *Old Persian*, and of which the Zend is undoubtedly not the parent, though it is in some respects cognate; the *Sasanidan*, in which the inscriptions at Hájiábád, (which would presently form the subject of conversation,) and some similar inscriptions of the dynasty of Sasan, translated by the Baron de Sacy, are specimens; the *Pehlivi*, in which translations of the Zend writings and a few other works are found in the hands of the Pársís, and which is held by Westergaard to be only a dialectic form of the Persian, misread by the Pársís, in consequence of the use of an imperfect and ambiguous alphabet, and which is denominated by Spiegel the *Párs*i, and said by him to be intermediate between the language of the Sasanidan inscriptions and that of the Sháh-Námah of Firdausi; the *Asmáni Zabán* of the Dasátír, now admitted by all to be a fabrication; and the *Persian*, properly so called, in which all the works of Irán since the days of Firdausi appear.

Respecting the last mentioned language, Mr. Romer maintains that its connections with the other languages, with the exception of the so called Pehlivi, which appears substantially identical with it, notwithstanding the assertion of certain of the Pársís to the contrary, are exceedingly remote and insignificant, and by no means of the character long alleged by some of the able and zealous Orientalists of the Continent. The claims to genuineness urged in behalf of the Zend he (Mr. Romer) disputes, as resting on insufficient grounds, particularly as no vestiges of it as a language ever spoken can be found; its historical connections cannot be traced; its structure and form are entirely diverse from the Persian, especially in its having inflexions, while the Persian has none; its literature is frivolous and absurd in its character; and its undoubted relations to the Sanskrit seem artificial and suspicious. He calls upon Dr. Wilson to "undertake the task of a careful re-exami-

nation of the points which have satisfied him as to the genuineness of the Zend," particularly as he has renounced all faith in the authenticity of the Pehlivi as a distinct language, by giving in his adherence to the views of Westergaard.

Dr. Wilson also stated, that though his views of the Zend remain unchanged, and are founded, not only on the analogies which it bears to most of the languages of the Indo-Germanic family, both near and remote, but also on various, though brief, geographical and historical allusions which it contains, and on certain analogies, and at the same time antagonisms, to the oldest forms of Hinduism which it expresses, yet the request of one so much venerated in Bombay as Mr. Romer, and who conducts his discussions with a happy union of spirit and courtesy, had been received by him with the greatest respect. He concluded by moving that the Society express the high gratification with which they have received Mr. Romer's communication, and resolve to insert it in the Journal of the Society. Dr. Wilson's motion having been seconded by A. Malet, Esq., *Vice-President*, was unanimously adopted.]

THE lieutenants of the Caliph Omar but too faithfully obeyed their master's command to destroy all the books found in Persia, so that, in no long time after the conquest of the country by the Arabs in the middle of the seventh century, the whole body of Persian literature had disappeared; and the execution of this barbarian order was so complete, that three hundred years afterwards, when Firdausi wrote his immortal poem, one or two works, only, relating to former times, were found, from which, and from tradition, is derived, it is said, much of the historical lore, real or imaginary, so beautifully wrought out in the "Sháh-Námah."* By the modern Pársís, however, whose notions of history may be judged by the fact, this devastation of the learning and religious books of their ancestors is attributed to Alexander.†

But although both religion and empire fell before the conquering arms of the Musalmans, and although a comparatively very small number of the people ultimately remained true to the ancient faith, the original structure of the Persian language was not thereby affected in the smallest degree. Firdausi wrote in this language, employing occasionally ‡ a word from the Arabic, which had then begun to be introduced into Persian, without in any way altering the grammatical

* Moses of Chorone, as appears in his History of Armenia, written five hundred years before Firdausi, was acquainted with what he designated the fables of Persia, and among them quotes the story of Zohak and his two serpents.—*Bom. Lit. Trans.* vol. ii. p. 152.

† [This is done in many works of the Pársís, both in print and MS. Yet, with as much absurdity on the other hand, it is alleged in the Dasátír that Alexander himself became a convert to Zoroastrianism !—J. W.]

‡ Kennedy, taking part of the text, found, in passages of one thousand couplets each—in the first thousand, fifty-four Arabic words; in the second, thirty; and in the third, forty-six: not quite five words to each hundred verses.

form of that ancient tongue; indeed, to have done so must have effected a radical change, for in genius, character, and grammatical structure no two languages can be more dissimilar; and hence, as no relics of the old literature of Persia survive, we cannot ascend higher than to the works of Firdausi, Rudakí, Kháqáni, and some others, for a knowledge of the written language of Persia, nine hundred years ago. Yet the state in which this language then existed, and still exists, regular, copious, and esteemed by Muhammad for its "extreme sweetness," exhibits qualities which approximate, as near as human speech can be supposed to reach, a formation all but indestructible. There are, therefore, no grounds for assuming that it was spoken under this or that dynasty; all that is known with certainty is that the Persian language dates from remote antiquity, and that, with other languages, which he mentions, is, according to Kennedy, "in exactly the same state at the present day as it was three thousand years ago."

Turning to the opinions of other Orientalists, we find Kennedy's position, of Persian being a distinct tongue without affinities, met by a belief that there exists between Sanskrit and Persian "the consanguinity of sisters," a common progenitor being imagined; and that although at present not apparent, there was a time when Persian posesssed inflexions. Both these hypotheses are rejected by Kennedy, 1*st*, from the absolute dissimilarity of the two languages in grammatical structure, and 2*ndly* that nothing more conclusive than conjecture is producible as to the time when, and cause why, the Persian underwent the loss of its inflexions. In support, however, of the first opinion, the language of one of the Behistun inscriptions is adduced, as showing that inflexions appear in what is certainly the ancient portion itself.

But, receiving as incontestable Kennedy's statement, "that not the slightest indication exists, either in tradition or history, which shows that previous to the Arabian conquest any foreign influence operated the slightest change on the Persian language," I can discover nothing indicating even the probability of the Persian first possessing and then losing its inflexions. The argument on this point, which might be founded on an examination of the Behistun inscriptions, would deserve all attention, could we feel assured that the Zend there inscribed was in the vernacular and spoken language of Persia in the time of Darius Hystaspes. But, as Grötefund observes, from the cuneiform characters being distinguished by the total absence of curves, it would seem to be destined to be cut on stone, or some solid material, for inscriptions, monuments, &c. as a sacred lapidary writing, never in

common use, the inference may be admitted that the "petrographic" writings at Behistun, consecrated to recording the glories of the monarch's reign, are not written in the common language of the people.

On this Colonel Rawlinson observes :—"It is certain that the language of the inscriptions is not a derivation from the Zend : the two forms of speech may possibly have existed synchronously, one as a demotic, and the other as a hieratical language ; but in that case the disfigurement of historical names, and the striving after artificial etymologies, which occur in every page of the Zendávesta, are points which will hardly admit of explanation." The Colonel just before had stated his inability to subscribe to the opinion of Burnouf, that "the Zend was immediately cognate with the Vedic Sanskrit," or that it was ever a spoken language. (Jl. As. Soc. Part i. vol. x. note, p. 51.)

At page 13 of the above, Colonel Rawlinson remarks :—"It must be remembered that the Persian of the ante-Alexandrian ages has long ceased to be a living language" ; and at page 50 he speaks of "the change the Persian language was gradually undergoing as it came into more general and vernacular use. As the tendency, indeed, of its popular employment, must have necessarily been to emancipate it from the technicalities of nice grammatical propriety under which it appears in its earliest form, and for which it was, no doubt, indebted to careful written cultivation, I should be inclined to assign the period of Alexander's conquest as the probable era from which we may date its bifurcation into the two distinct channels that it would appear to have subsequently pursued. I would suppose, that on the one hand as an oral dialect it lost its compounds, and many of its distinctive articulations, its redundant relatives, its inflexions of case and gender ; and that it thus gradually subsided into the vernacular form which it possessed, probably, on the institution of the Sassanian monarchy, and which continued with little variation to the Arabian conquest. On the other hand, also, I would conjecture, that whilst it was still in the enjoyment of much of its original vigour and flexibility, it was taken up by the priesthood as a vehicle for religious teaching ; that it was modified and augmented by further intercourse with its cognate branches to the eastward ; and that, as a general dialect, it was refined and systematized by sacerdotal care, until it became finally embodied in the highly artificial forms of alphabetical expression, and of grammatical structure, which we find it to exhibit at the present day in the Hagiographic books of the Pársís." These opinions will be examined in the sequel.

Nothwithstanding the entire destruction of ancient Persian literature,

and a destiny quite the opposite of that of the "most copious, the most expressive, and the most harmonious of languages," the Greek, which for the space of two thousand five hundred years—to the capture of Constantinople—remained the same language, a singular fact occurs in the history of the last, strongly contrasting its fate with that of Persian. A late writer,* in his examination of the character of ancient and modern Greek, describes in full the process of degradation which the Hellenic language has undergone in its transformation into Romaic. Now, on Persian no such degradation or transformation has attended: it continues, to this day, as it has always been, in the country in which it was first spoken, the living tongue above described, the unchanged vehicle of speech and thought of successive powerful peoples.

Proceeding, then, to the principal object of this paper,—an examination of the asserted authenticity of the language called Zend,—we find a writer in a late number of the *Edinburgh Review* speaking of it in these terms:—"The language of the *Zendávesta*, most intimately connected with the language of the *Veda*, the inscriptions of Cyrus, Darius, and Xerxes, and the Pazend or Persian spoken under the Sassanian dynasty, the grand epic of Firdausi, and the language now spoken in the country, exhibit a complete biography of the Persian tongue." But, passing over the blunder of making Pazend "pure Persian" spoken under the Sassanian or any other dynasty, when, as the name itself implies, it is nothing more than the language, Persian or other, written in explanatory fashion *below* the Zend text, it may be inquired on what authority, or with what reason, does the reviewer place the Zendávesta at the top of his biographical sketch of the language of Persia. It was Sir William Jones who first observed the number of Sanskrit words found in Zend, and the grammatical relations subsisting between them. All our knowledge of Zend is derived from, and confined to, the contents of four or five books produced by the Párs'ís, and by them affirmed to be the writings of their prophet Zerdusht or Zoroaster. These manuscripts are of no antiquity; perhaps some copies may be found written between three and four hundred years ago.† Their subject is the exhibition, together with an

* Finlay's History of Greece.

† [The oldest Zend MS. of the Vendidád now in the possession of the Párs'ís of India bears the date A. Y. 987 (A. D. 1617). It was written in Persia. A portion of the Vendidád, however, sold by them to Professor Rask, and now in the Royal Library at Copenhagen, bears the date of A. Y. 673 (A. D. 1303), which Professor Westergaard considers genuine. A fragment of the same MS., or of another of

absurd cosmogony, of the doctrines, rules, and observances of a polytheistical worship, devoid of all worth or regard as of pretended institutions, divine or human, so amply exposed by Dr. Wilson in his work on "The Pársí Religion."

The opinions of Sir William Jones and Richardson, adverse to the acknowledgment of the Zend to a place among genuine languages, are well known, and have met the full concurrence of that sound and able philologist, the late General Vans Kennedy, who states:*—"But the sole authority on which the Zend and Pehlivi books depend is the traditions of the Pársís. Before, however, these traditions can be admitted as testimony, it must be satisfactorily proved that the *Zendávesta* and its Pehlivi translation actually existed at the time of the Arabian conquest, and that they have been carefully preserved until the present day by the Pársís of Persia and India. But no such proof has ever been adduced, nor has it been yet established, that the Pársís of either country possess any well-authenticated traditions, which ascend uninterruptedly up to that event. On the contrary, the silence of Tabari and Firdausi respecting them is a strong presumption that they were not invented at the time when these writers lived." Colonel Rawlinson, however, in a memorandum, written at Bombay, in 1840,† takes a totally opposite view of the Zend, and thus expresses his opinion:—"It has been asserted by some of our most distinguished British Orientalists, that the language in which the sacred writings of the Pársís is composed is a fabrication of the Zoroastrian priests, subsequent to their expatriation from Persia; and that these writings, in consequence, are, as far as regards antiquity, entitled to no consideration whatever. Against this assertion I offer the following remark: in various parts of Persia are to be found, at the present day, inscriptions in a character which we denominate cuneiform, exhibiting historical records of the sixth and fifth centuries before Christ, written in three different languages." . . . . . "To the analysis of these characters, and the examination of this language, I have devoted many years of research; and I can now safely assert, that the Persian language of the ages of Cyrus and Darius is unquestionably the parent

the same time and place (Cambay), is in London. A copy of the Yaçna, also from Cambay, and now at Copenhagen, was written A. Y. 692 (A. D. 1322). The other Zend MSS. at Copenhagen, Paris, London, Oxford, and in my own collection in Bombay, with the exception of a single fragment, perhaps, are of posterior dates.—J. W.]

* Researches, &c. p. 168.

† Wilson on the Pársí Religion, p. 402.

of that tongue which we call the Zend, and which has been so successfully elaborated by Continental students, and by none with greater skill and perspicuity than Mons. Burnouf, in his admirable '*Commentaire sur l'Yaçna.*' I am merely desirous, on the grounds I have mentioned, to record my conviction that the Pársí writings were imported from Persia, in their present state, during the seventh century of Christ, and are thus entitled to the same degree of consideration among the Pársís of the present day which they enjoyed among their ancestors at the period of expatriation."

Dr. Wilson observes:*—"Whether or not the Pársí priests in India, from their traditional reminiscences of the ancient languages, could have fabricated some of the Zend writings, I shall not positively assert. There is a poverty of expression in some of these writings, particularly of the minor liturgical pieces, which shows that their authors had no ready command of the language in which they wrote. There is an approach to Gujarátí idiom in some instances, and to a Gujarátí corruption of Sanskrit, which at one time awakened considerable suspicions in my mind. Viewing the matter of the Zend language, however, in its general aspect, I have no hesitation in declaring that none of the exiled and depressed Pársí priests in India can be supposed to have had the ability to invent that language,† with its extensive grammatical forms, and with its abundant and regular analogies to the Sanskrit, Persian, Latin, and Germanic languages, as so distinctly evinced by Bopp and Burnouf."

It is to be regretted that Dr. Wilson, remembering Kennedy's filiation of certain languages from Babylonian or Sanskrit, to the exclusion of Persian, did not abide by and work out his earliest impressions as to whence the fabricators of Zend drew the materials for their work. But as he has relinquished faith in the authenticity of Pehlivi, as will appear presently, he may possibly undertake the task of a careful re-examination of the points which have satisfied him as to the genuineness of Zend.

The works of Professor Bopp and M. Burnouf are to be regarded with great respect for the erudition, labour, and research, and yet more especially for the abounding imagination and rare ingenuity, they exhibit. But they may, without presumption, be asked, what facts in the history of the Zend, elucidatory of its existence as a real language, has the employment of so much time and industry discovered? Colo-

* Pársí Religion, p. 400.

† The Pársís of India were not entirely unlearned, for we know that three centuries ago they had translated the Pehlivi version of the Vendidád into Sanskrit.

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nel Rawlinson, as has been seen, inverts the order of succession attributed to the languages of Persia by Anquetil du Perron. This point is not noticed by Bopp or Burnouf; but it would have been information of real value had these learned persons been able to show, from some authentic record, the time when, the country where, and the people by whom, the Zend was spoken and written;—for such knowledge we look in vain.

The conclusion arrived at from a fair examination of these premises appears to be, that the language of the Zendávesta is pure invention, wanting in all the essentials of vitality. There is no proof, and the mode of its composition, entirely artificial, contradicts the idea, of its ever having been found as the interpreter of thought or volition in the mouth of man, woman, or child;—a sort of galvanic existence only may be perceived in it, produced by a not unskilful adaptation of the flexible powers of Sanskrit grammar in working up materials supplied from that language. In Anquetil's Vocabulary, further, may be found the following seven Zend words, belonging to the dialect of Gujarát, viz:—"*Bee*, deux; *toum*, tu; *zeante* (janto), connaissant; *gnato* (nahato), lavant; *te*, toi; *kerete* (karto), faisant; *petche*, derrière. Also the signs of the genitive case in Gujarátí, *no*, *ne*, are sometimes affixed, as in the (appropriated) Turkish word *aspereno*, observer. (Researches, p. 172.) Comparative philology, like comparative anatomy, may have all the value claimed for it, provided care be taken that it operates upon real subjects, and not on counterfeits. These essentials must not be taken for granted. The forgeries of the writer of the "Asmáni Zabán," of the "Dasátír," and of the language of Formosa,* by G. Salmanazor, are instances of what may be done by unscrupulous and bold invention. But Mullá Firuz, shutting his eyes to the clumsy forgery, affects to believe the language of the Asmáni Zabán to be genuine, and professes to have such a knowledge of it as enabled him to correct mistakes of the transcriber, and to supply omissions in the translation. He says (Dasátír, vol. ii. p. 16):—"Wherefore this humble Firuz, according to the best of his poor understanding, has rendered the translation conformable to the text, and inserted it above." The learned Mullá, also, thought that his copy of the book was the only one extant. It was not. Other copies were subsequently discovered: one found at Surat was sent to the Bombay Literary Society.

Sir William Jones never saw the Dasátír. He only knew the book

* Historical and Geographical Description of Formosa. London: 1704.

from what he found concerning it in the "Dabistán." This accounts for the erroneous estimation in which it was held by him. The Dabistán itself was quite unworthy of the praise he lavished upon it; for of these mistakes in judgment the late Mr. Erskine truly observes :— "The history of letters seems to me scarcely to afford an instance of a more perverted judgment on historical evidence." But, on the other hand, how Mr. Duncan, with his natural sagacity and cultivated intellect, could take the Dasátír for a treasury of Oriental literature, undertake a translation of it, and "intend, on his return to England, to present it to His Majesty as the most valuable tribute which he could bring from the East," (Bom. Lit. Trans. pp. 342, 349,) has always appeared to me most incomprehensible.

Professor Lassen, it is said, is engaged in preparing a grammar of the Zend; a work, should he undertake it, of no great difficulty to a Sanskrit scholar so profoundly versed in the language as he is. The learned Professor has only to apply the rules of the Vyákaran to his purpose, when the Zendo-Sanskrit words will readily submit to the process required, through moods, tenses, and inflections. Yet this, if ever so successfully performed, will afford no proof of the authenticity of the Zend, because by a similar operation, applying the rules of Persian grammar, a grammar of the notoriously fictitious language of the Dasátír may be as easily produced.

The examination of another language most intimately connected with the Zend now naturally follows: this is the Pehlivi. The Zend text of the Vendidád, and its translation, as it is called, into Pehlivi, are in all probability cotemporaneous; that is, they were composed *(invented)* about the same time, and are held in equal reverence by the Párs'ís. Hitherto the opinions of English Orientalists adverse to the authenticity of this language have not been deemed valid by the Oriental scholars of the Continent. Professor Westergaard, however, has lately seen reason to take a different view of the question, and expresses his latest opinion on the subject to Dr. Wilson, of Bombay, to the following effect—"That on a critical examination of the so-called Pehlivi writings, he found them not to be in any Sassanian language, but merely in a dialect (probably the Kirmanian) of the modern Persian, disguised by the use of an imperfect alphabet, often now misread by the Párs'ís, the Shemitic words introduced into it being merely corrupted Arabic." With this opinion Dr. Wilson entirely agrees.*

I would here introduce a word or two regarding *unfabricated Pehlivi;*

* [Mullá Rustamjí informs me that his learned uncle, the late Mullá Firuz, had come pretty much to the same opinion.—J. W.]

and observe, that before assigning any precise signification to them, we should ascertain by whom, in what manner, and to what language the genuine *Pehlivi*, also named *Pársí*, was originally, in these terms, applied. This may be easily done; and it is necessary, for a distinction which has no existence has been assumed. Dr. Spiegel is said to consider the Pársí to be the language of Persia *between* the genuine Pehlivi of the Sassanians and the Persian of the Sháh-Námah. On examination, this opinion will be found quite inadmissible. Let us ascend to the earliest authority by whom the words "Pehlivi" and "Pársí" were, certainly, first used, Firdausi, and we discover at once their true meaning and acceptation, now obscured by modern theories. His testimony plainly establishes the fact, that instead of distinctions and modifications existing between Sassanian Pehlivi and the Persian of the Sháh-Námah, they are absolutely identical; and the language named by Firdausi indifferently "Pehlivi" and "Pársí" is precisely that in which his poem is written—for he says:

"Bipardákhtan daftar-i-*Pehlaví*."

* * * *

"Ajam zinda kardam ba in *Pársí*."

And thus, unless we deny the author the power and right to inform his readers in what language he writes, his evidence is conclusive, and the question determined.*

About the time these circumstances became known to the writer of these Notices, an opportunity of communicating with Professor Lassen occurred. The learned Professor had sent to the Asiatic Society a portion of the text (the first five chapters) of the Vendidád, then just published by him. Finding that the Pehlivi translation was not given with the text, or noticed in an accompanying short preface, the writer offered for the acceptance of Professor Lassen some extracts he possessed of the book, which contained, with the Zend text, a Pehlivi translation; forwarding with these papers three letters, which under the signature of "Kámgár," had appeared in *Allen*'s *Indian Mail*. He also, in the letter addressed to Professor Lassen on the occasion, referred to the opinion of Professor Westergaard, as detailed above, sending for this purpose the transcript of a few lines he had written to Dr. Wilson on the subject.

Professor Lassen, in a courteous answer, expressed his regret at not being able to subscribe to the writer's views of the Zend language, "which he considers to be a genuine one, chiefly on two grounds:

* Abridged from Researches, pp. 165, 166.

first, that it agrees so intimately in its system of consonants with the ancient Persian, that it must be considered to have been a sister-language, chiefly distinguished by its vowel system, which exhibits several distinct traces of a modern state. And that it would, in the second place, be necessary to suppose, if the Zend language was fictitious, that the Pársís possessed a knowledge of comparative grammar, the Zend being rich in Indo-Germanic analogies."

To this it was replied, that putting the Zend and Persian, without adverting to some common progenitor, in the relationship of sisters, was new and worthy of consideration, taken in connection with the other distinct opinions on the question, those of Anquetil du Perron, of Colonel Rawlinson, of Sir W. Jones, and other English Orientalists. That it was far from clear how the agreement of the Zend in its consonantal system with that of the Persian was proof of the relationship assigned to them. The same alliance might be said to exist between the Persian and the "Asmáni Zabán," for both use the same alphabet, and the letters have the same powers. And further it was remarked, there could be no doubt, that for some time after the Arabian conquest the Persian language continued to be written in its ancient indigenous character,* (eventually superseded by the modern Arabic alphabet, itself an off-shoot of Syriac,) the same character which is now employed in writing Zend, and is sometimes used for writing Persian at the present day. But above all, it was observed, that as the vowel system of the ancient Persian character was identical with that of the Sanskrit,† it must have lent its aid, in no small degree, to facilitate the presumed composition of the Zend.‡

It has been said that analogy exists, in regard to the loss of inflexions, between the English language and Persian. I have not been able to discover this, but rather the reverse. From, we will say, the age of

* A perfect system of letters ought to contain one specific symbol for every sound used in pronouncing the language to which they belonged. In this respect the *Old Persian* or Zend approaches to perfection.—*Sir William Jones.*

† There are also some Sanskrit aspirates under arbitrary forms of letters, unknown to the ancient Persian alphabet, and this shows the attention paid to using Sanskrit with effect.

‡ In regard to *analogies*, it might have been added, that the attempt to identify the Bengali word *bohini* with the Sanskrit word *svasri*, by the permutation and excision of letters, shows how far a philologist may be misled who misapplies his rules, and permits fancy to supersede judgment.—*Edinburgh Review, October* 1851.

[The Bengali *bohini* is obviously derived from the Sanskrit *bhaginí*, a sister. The word *svasri* has its correspondents in the German *schwester* and English *sister*.—J. W.]

Alfred to that of Shakspeare, an interval of about seven hundred years, the rude Anglo-Saxon, gradually dropping most of its inflexions, and adopting foreign words to an unlimited extent, has become in the process of time the copious, expressive, polished, and flexible English in use. But the speech of Persia, we are sure, for the last thousand years, has remained the same perfect tongue, unaltered in its grammatical structure, we read in the Sháh-Námah. And judging from proper names found under Greek forms in the historians of Alexander, such as "Parysatis" for "*Parí-zádah.*" fairy-born ; "Roxana" for "*Raushanak,*" little splendour ; and others, there appears no reason to doubt that the Persian of that day was the same tongue in which Firdausi wrote. The use of the diminutive *k* in "Raushana*k,*" as the same letter, with similar effect, is employed in "Marda*k,*" manikin. "Pesara*k,*" little boy, in modern Persian, affords a pregnant instance of their identity.

In the sequel, Professor Lassen mentioned, that, having no accurate knowledge of Pehlivi, he declined offering any opinion on Professor Westergaard's views of it. This is unfortunate, for M. Burnouf considers the Pehlivi translation to be an indispensable adjunct to the Zend text, but if ultimately considered as spurious, Zend must run the risk of undergoing the same fate, unless some adequate cause can be found or imagined for joining a fabricated translation to a true text, and acknowledging both with equal religious respect.

M. Burnouf (Preface l'Yaçna, p. xxiii.) says, "*On peut donc regarder comme un fait certain, quoiqu'il manque à cette assertion la preuve la plus décisive, c'est à dire la comparaison du texte Pehlvie lui-même avec la traduction Sanskrite, que la travail du Neriosengh est une copie fort exacte de la version Pehlvie, qui existait, il y a trois siècles dans la Guzarate.*"

This then is the country, there remains little doubt, where, in communication with their co-religionists of Kirman, with whom a most intimate intercourse has always been maintained, both languages were invented by the Pársís of India.

Resuming, as proposed, a further consideration of Colonel Rawlinson's opinion, we find two hypotheses brought forward—1*st*, that ancient Persian once possessed, and afterwards lost its inflexions. In answer to this it will be sufficient to repeat, as has already been shown, that conjecture is substituted to establish facts which, if in existence, might be easily exhibited. For the 2*nd*, I place the proposition and reply together, and say that to reply that the poor, rugged, and unspoken language, the Zend of the Vendidád, was derived from the Persian of any age, and through a process of "sacerdotal care" and refinement so

circumstantially described, arrived at the perfection of language claimed for it, seems to me so inconsistent with safe conclusions from premises ascertained, and to present such a fancy picture, differing *toto cœlo* from the true character of the language in question, that I fairly confess myself at a loss how to deal with these assumptions, and must be content to quote in my defence a Hindustání proverb which thus runs—"Bhárí pathar chorneko chhoro."

Colonel Rawlinson, in continuation, it may be observed, admits that the Zend was not ever a spoken language. Mr. Erskine thought the same; and this being the case, it may, wheresoever *derived*, according to some, or by whomsoever *invented*, according to others, without dispute be taken by both as a *hieratical*, and not a *demotic* language. Dr. Wilson's analysis of the twenty-two "Fargards" or chapters of the Vendidád will afford to any one desirous of acquiring it a full knowledge of the scope and value of the "religious tendency" of that book.

Long ago, when residing among Párs'ís at Broach and Surat, the question of the authenticity of the Zend engaged my attention. In this, my sole object, at that time and since, has been the development of truth: truth is indestructible, but it does not escape defacement. Should the sequel show that I am mistaken in my conclusions, the triumph of truth will be my sufficient reward.

As I close this paper, I see that the cause of Zend literature is receiving progressive attention. Dr. Spiegel, Professor of Oriental Languages at Erlangen, with others, is thus engaged. The learned Professor has in the press at Vienna an edition of the Zendávesta, consisting of three vols. 8vo., and containing the original text, the Pehlivi version, a copious list of various readings, and a German translation of the whole. [Professor Westergaard at Copenhagen, too, has in the press a critical edition of the whole of the Zend Texts, with an English translation, grammar of the two Zend dialects, a copious concordance and dictionary, dissertations on the Iranian antiquities, etc.]

*November*, 1852.

## NOTE.

A writer in the *Quarterly Review*, No. 113, p. 82, thus expresses his opinion of Kennedy as an author: "General Vans Kennedy, in his elaborate 'Researches,' &c. goes so far as to affirm that the 'British Celtic language has no connection with the languages of the East, either in words, or phrases, or the construction of sentences, or the pronunciation of letters.' This positive declaration from a man of undoubted information and research might seem decisive of the question. But

when we find that he denied in equally positive terms the affinity between Sanskrit and Persian, which Sir W. Jones and Professor Bopp have made as clear as the noon-day sun, we may be permitted to suspect that in this case he has pronounced his verdict rather hastily." Now on this it may be remarked, that Sir W. Jones, although stating something to this effect, never deliberately maintained such an opinion as is here attributed to him, and that Professor Bopp can only exhibit what truly exists, not what is fancied; while on the contrary Kennedy proves his assertion by a masterly array of facts and lucid reasoning, concluding his argument in these words:—"But these fully prove, that though the Persian is not derived from Sanskrit, still the Persians must have had, at some remote period, a most intimate intercourse with a people who spoke that tongue." * * * "For, if not, it must necessarily follow, that, notwithstanding the numerous Sanskrit words it contains, Persian was not derived from Sanskrit." Having previously (p. 190) said, "This people speaking Sanskrit could be no other than a numerous colony which had migrated from Babylon, on its conquest by the Ninus of Herodotus, part of which established itself in Persia, and part proceeded on to India."—*Researches*, p. 267.

ART. VI.—*A description of the Salt-water lake called the Null, situated on the Isthmus of Kattyawar.* By Major FULJAMES, Bombay Army, Political Agent, Riwa Kanta.

Presented 17th March 1853.

THE Null is a large lake of brackish water 37 miles SW by W. from the city of Ahmedabad, and situated on the western frontier of the Dholka purgunna. It extends over a measured area of 31,500 acres, or 49½ square miles. Of this, 22,796 acres, or 35½ square miles, were actually covered with water at the time its outline was surveyed in February 1824.

In general character it is shallow, rarely exceeding 6 feet, and muddy in those parts which are free of weeds, but quite clear where these abound; thick, nearly impenetrable, masses of bulrushes and high grass surround the western, southern, and northern shores of the lake, for a considerable distance inland; the eastern shore is generally open, and free of rushes. No perceptible bank appears, and the country that borders on it is a dreary, desolate flat, though in some places with a vegetation of the rankest and most unwholesome nature.

On its eastern side there are some very remarkable undulations, which bear a remote similarity to the Mor Puna, or sandy hillocks that skirt the sea-shore between the Tapti and Nurbudda rivers. It is also worthy of remark that those undulations are composed, as far as I have been able to examine, of drift-sand; that they extend at considerable intervals from the eastern side of the Null in a north-westerly and south-easterly direction, as if thrown up by the action of the waves of the sea by a south-west swell. Such sand ridges are to be met with near the western and southern base of Mount Aboo.

From the usual bearing of the ridges, and in the present absence of the sea, it may be inferred that the action of the south-west winds have assisted their formation, as the sea would have done, for these winds must blow during the monsoon with great violence over such an otherwise level country; the soil being in most places a loose, fine,

reddish and whitish sand, easily acted upon by any wind that blows. Between the ridges are extensive bays, having a crust of salt on them, bare of all vegetation; in fact they resemble those bays to be seen along the coast which are inundated by each flood tide. They extend east as far as Jeytapoor, a distance of 8 miles.

Sometimes these sandy undulations run east and west, and there are some remarkable ones in the vicinity of Ahmedabad, lying in this manner. Wherever they have been cut through by the rush of water during the monsoon, their appearance is that of a high bank of fine loose sand, with small nodules of lime, called kunkur, dispersed throughout it. Sometimes a few small Mollusca are seen; for instance, *Planorbis corneus, Lymnæa stagnalis, Scalaria pretiosa,* and *Solarium,* also a large *Ampullaria globosa,* of which I enclose a drawing.

It is possible some of these undulations may have been formed in the first instance by some upheaving force from below, for we have abundant proof in many parts of the western portions of Guzerat that they have at remote and recent periods been much disturbed by volcanic agency: the former is evident from faults in the sandstone rocks near Ahmednuggur, 60 miles north of Ahmedabad, and from the basaltic dykes which have been forced up through horizontal beds of fine sandstone both in Kattyawar and Cutch; a very good example of which is to be seen at the town of Than, 38 miles north-east of Rajcote. The formation is a reddish compact sandstone, the strata of which appear horizontal. Through these strata, a dyke of columnar basalt has been forced: the dyke is about 8 feet wide, and appears to have been forced vertically, though the columns lie horizontal, like the strata of sandstone; a white calcareous cement appears at the divisions of the columns. The dyke crops out to the surface, and can be traced a considerable distance as forming the bund of the tank at Than. It strikes north and south. The people of Than have turned the dyke to good account in forming wells by extracting the basalt, which from its columnar formation is easily done, and leaving the sandstone on either side untouched. Apparently an abundant supply of good water from the sandstone is procured. The wells to a casual observer appear as if excavated from the sandstone rock, but a close examination shows the way they are made.

Of the more recent effects of volcanic agency the earthquake in the year 1819 is a good example, for it was felt the length and breadth of the province of Guzerat, and has left the most lasting marks of its

mighty power both at Ahmedabad and in Cutch. One of the finest mosques at the former place, called the Jumma Musjid, was much injured, and its stone minarets, which were very remarkable for vibrating on any person ascending to their summit and rocking himself from one side to the other, were hurled to the ground. Many other mosques, though built most substantially of stone, were rent and cracked in all directions.

This earthquake had an extraordinary effect on the springs of water in the wells in many parts of the Ahmedabad Collectorate: in the lands of the villages of Tajpoor, Changodur, Sunathul, Telaow, and others to the south-west of the city, and from 6 to 10 miles distant, previous to the earthquake, brackish water was found from 60 to 70 feet from the surface; subsequent to the earthquake sweet water was found in the same lands at from 15 to 30 feet from the surface. Similar changes, though with a contrary effect, were observed in the wells of many villages some 30 miles south of the city, particularly at Roopaul and Santhul, in the Dholka purgunna: wells that held sweet water became salt, and totally unfit for any purposes, and remain so to this day.

The object of this digression is to show that the Null may have been formed by this agency either having caused a sinking of the country which the Null now covers, or by having upraised the land it occupies, and which divides Kattyawar from Guzerat. This latter theory I am inclined (after a careful inspection of the country in all directions) to advocate, and will adduce some remarks in support of it.

Immediately north of the Null, and about 20 miles distant, is the present most southern extremity of the smaller Runn. There is, however, a rain water channel, extending many miles from this point in the direction of the Null, and which acts as the natural drain of the country, by carrying off the water into the Little Runn. From the southern extremity of the Null the country is a low, salt flat or plain, very similar in appearance to the Runn itself, over which the superfluous waters of the Null, by passing, have in a series of years excavated the present rivers called the Bogawa and Oonkar, which unite near the village of Dhunala, 20 miles south; from hence the Bogawa flows in a south-easterly direction, until it joins the Saburmutti river, a few miles above its embouchure into the Gulf of Cambay.

The country on either side of the lake is called by the people the Null Kantha, or Cantha, a definition of which the following extract from Colonel Todd's Western India will explain:—"*Cantha* is not only the general designation for a coast or margin, but is to this day

especially applied to all the portion of Cutch lying between the hills and the sea; and the application of the term *Trinus* by Arrian must have been restricted to the fenny portion of the head of the gulf (Colpus) familiarly known as the *Rin* or *Runn*, a corruption of the Sanskrit word *Aranya*, or waste. In like manner the phrase *Erinas* used by the first Arrian must be used to designate the greater Rin or Runn, which, uniting as it does with the smaller, actually makes Cutch insular."

I believe it is generally admitted that both the larger and smaller Runns were at one time covered with sea water, and they therefore must have been connected with the sea by either the Gulf of Cutch or the Luckput Channel, or, more likely, by both. It is also commonly believed that the depth of water was such as to enable boats to ply from one point to another. By an inspection of the country I am led to believe there was formerly a third direct connection with the sea by the Gulf of Cambay, and along the low salt country leading to the Null, and from thence to the Little Runn. If such was the case, the present Peninsula of Kattyawar would then have been an island, like Cutch.

It will be seen, either by personal examination, or by an inspection of a good map of Kattyawar, that, taking the range of hills near Jusdum and Choteyla as a centre, all the rivers run to every point of the compass: those on the east into the Null and Gulf of Cambay; those to the north falling into the Little Runn; those on the south into the sea; and those on the west into the Gulf of Cutch. It will also be observed that the only streams that exist on the eastern or Dholka side of the Null flow to the west, while those on the Kattyawar side flow east, distinctly showing the dip of the country, and that the Null is even now the lowest part.

It is curious, also, to observe, that from the western side of the Null until you reach the Vindiya range of mountains, on the eastern side of the Myhi river, a distance in a direct line of above 80 miles, there is no river flowing from the west to the east; one and all flow from the north-east and east to the west and south-west.

That the Gulf of Cambay had a very different outline to what it has at present, and that it extended much further north, is apparent from the formation of the country, from salt-water bushes or trees being constantly seen very long distances inland, and from tracts of country having the barren and saline appearance so remarkable along the shores of the Gulf and in the two Runns; besides, the water in the wells in such localities being usually salt or brackish.

During the comparatively short time of twenty-three years I have resided in this province, some extraordinary changes have taken place, which it may be interesting to record, if merely for the sake of showing how easily in a soil like that which exists in the localities I am writing about, new rivers or channels are formed; and how easily a body of water, such as we may suppose the Runn to have been, may have been drained off, and its former channels closed up.

In the first instance, I may mention the Bhadur river, which usually flowed past Ranpoor and Dundooka, and formed the creek of the port of Dhollera. In the year 1817, and subsequently in 1833-34, owing to some unknown cause, it left its channel about 4 miles west of Dundooka, and during the latter period cut for itself an entirely new channel, a distance of 15 miles in a north-easterly direction, and united its waters with those of the Null which flow down the Bogawa river, the point of junction being near the village of Huddala.

In 1824 it is mentioned in the survey report that the tides extended as far as Huddala. In January 1850 they extended many miles further up, and during heavy floods the waters from the Null and the surrounding country, which is frequently for many miles in extent under water, must be united; from which cause the brackishness of the water of the Null may be attributed, though, strange to say, this brackishness does not show itself until some months after the cessation of the rain, and a considerable portion of the waters have been reduced by evaporation, and by being absorbed by the earth.

The village of Veckrea is situated on rising ground on the eastern shore of the Null, about half a mile distant. There are a good number of trees around the village. This rising ground affords a person a good view of the lake. The country within view looks bleak and desolate: there are a few trees near the eastern shore, and at one old tree is a place called Hinglaj Arra (ford or crossing). How this name originated I was unable to obtain any very satisfactory information, beyond that formerly it was said there was a temple called Hinglaj Mata* on an island in the Null, and that this was the ford or crossing to it. No remains of this temple are now to be seen, though the direction in which it was supposed to have been situated was pointed out. This was the only tradition of the antiquity of the Null which I could pick up.

I enclose with this paper three sketches of a most primitive kind of boat in general use on the Null, drawn by Dr. Seaward, of the Guzerat Irregular Horse. No other kind of boat appears to be used: this

* There is a sacred place of this name in Scinde.

seems to answer every purpose. It is easily made by the people on the spot, from the bulrushes which grow most luxuriantly. The dimensions of the "Trapa" or bulrush canoe are as follow :—extreme length 15 feet 3 inches; circumference in the widest part 3 feet 8 inches. Its make is peculiar; and when on the water it has a neat appearance, and can be propelled at a great velocity by a pole. The boatman stands upright on the part marked (*e*) in the side view of the trapa; the part marked (*c*) in the same view has the two sides and the front part raised, to prevent the water coming on board: here either passengers or goods are placed for security.

The construction of this primitive boat displays considerable skill, and it is very stiff on the water. From the section (*d*) it will be seen that from the point (*c*) the two side pieces separate and act as outriggers: the stern piece or main trunk of the canoe increases in size to midships, and tapers into the fork at (*c*) made by the bow pieces. All the parts are firmly bound together with bulrushes, and the canoe keeps the form, as shown in the drawing, even when lifted, which two men can easily do, one at either end.

Much larger trapas are made and are employed in taking people from one place to another, as well as different articles of food; also smuggled opium, which is taken in large quantities from the Guicowar districts across the Null into Kattyawar during the night. In February 1851, the time of my visit, the water of the Null was clear and sweet to the taste, but wherever a peculiar sort of grass was observed growing, the water was always clearer than in those parts where it was absent. In an iron punt, which I had brought for the purpose of examining the Null, it took us one hour with two men to punt straight across to the Kattyawar side. The natives calculate the distance across in a straight line at 3 cos, $4\frac{1}{2}$ miles.

There are few fish in the lake, and I only found the three or four kinds of shells mentioned.

The people along the shores use a peculiar sort of net for catching fish, called a "Champa." It is made of six sticks, 3 feet 6 inches in length, all secured at the upper end: the net is fastened to the lower end of the sticks, and it is spread like an umbrella when ready for use, and covers a circle of 6 feet in diameter. The upper end of the net is held by a loop on the finger, and the net is used by the person as he wades through the water up to his waist, or rather lower, by constantly raising the net and frame; and as he advances pushing it down on the bottom. If a fish comes within the circle, it immediately strikes against the net, which motion is at once communicated to the finger by

the loop ; when the man at once drops the loop from his finger, and the net falls to the bottom, the sticks remaining upright: hands and feet are then employed groping for the fish. When secured, the loop is again adjusted, and the man advances. It is usual for a number of them to fish together in a semi-circle, and their mode of fishing appears to have been copied from the large stork so frequently seen in all tanks and rivers in Guzerat. It is, however, difficult to describe, beyond there being an alternate motion of the net as it is lifted and pressed to the bottom, first on one side, then on the other, and then in front, as the fishermen advance across a piece of water.

The name of the Null, it strikes me, must have originated from its having at one time been the channel which natives would designate *nāl* or *null;* leading water from one place to another, as from the Runn into the Gulf of Cambay. Such channels are to be seen in the present day in the upper end of the Gulf of Cutch, as described in my paper on that locality, and if by any accident the three channels now existing in the Gulf of Cutch were closed up, we should have a similar, though larger, sheet of water than the Null at the head of the Gulf.

Lieutenant MacMurdo, of the Bombay Establishment, in 1813, describing this locality, states:— "An object deserving more notice and investigation than I am capable of affording is the Runn or swamp which surrounds the peninsula, and in fact makes it an island. The Gulf of Cutch penetrates as far as Patree and Bujjoima in Jhallawar, where it is joined by a similar swamp which is connected with the Gulf of Cambay near Dhollera. It would require a dissertation to do justice to this extraordinary piece of water; but I may observe, that it is unusually and visibly increasing on the west side. There is also a tradition well-known, and generally believed, that the voice of man could be heard from Cutch to Kattyawar; and opposite Jooira, now a sea port, there was a foot-path at low water; but such is the obscurity in which transactions of yesterday are involved among the natives of the country, that even this last circumstance, which is attributed to a comparatively modern date, or about two hundred years ago, is merely a legend, the truth of which is not substantiated by any facts or records."

There is a peculiar rank grass, or reed, which grows on the marshy lands adjoining the Null, which in seasons of scarcity affords food and employment to hundreds of poor people. The reed has a small bulbous root, of a dark colour, and covered with hair-like roots or fibres all over. This is dug up and dried in the sun; the fibres are carefully removed, and the root is then ground into flour. The bread

made from this has a sweetish, and by no means an unpleasant taste, something resembling ginger-bread. To those accustomed to it from their birth it is nutritious enough, but, incautiously eaten in any quantity by persons used to more wholesome food, it is apt to bring on violent dysentery, and inflammation of the bowels, often proving fatal. The fibres are supposed by the people to be a deadly poison. It is this reed alone that renders the ground on which it grows valuable, and an object of contention among the villages around the Null. The reed or grass part affords an excellent thatch for houses.

By the end of the month of March the water in the Null has become brackish, and as the hot season advances becomes more and more so, until it is unfit for any purpose. In some seasons, when the fall of rain during the monsoon has been very scanty, the waters of the Null disappear, when the ground must assume the exact appearance of the Runn.

I was much surprised at finding so few wild fowl on the Null, for when all the tanks around were swarming with wild ducks of all kinds, scarcely one was to be seen on the water of the Null, though immense flocks of cormorants, shags, cootes, and such like, were to be seen in all directions. From this I should gather that although the water of the Null appeared sweet to the taste, there must be some saline ingredients in it, which renders it unpalatable to wild duck, though snipe along the marshy edges were abundant.

A few fields of wheat on the eastern shore were irrigated from the waters of the Null when I visited it, and they appeared in a flourishing condition. Rice is also extensively irrigated from the Null, and is the chief produce from the lands near the lake during the monsoon.

For the plan, area, and some other information embodied in this paper, I am indebted to the records of the Revenue Survey made in 1824. The information then recorded is equally applicable now.

ART. VII.—*Buddhist Cave-Temples in the Circars of Baitalbari and Dowlatabad, in H. H. the Nizam's Dominions.* By W. H. BRADLEY, Esq., Surgeon, Bombay Army, attached to H. H. the Nizam's Service.

Presented 17th March 1853.

WITH the following descriptions of the Cave-temples of Baitalbari and Dowlatabad, in H. H. the Nizam's Dominions, which were first brought to the notice of the Cave-temple Committee by Captain Rose, (see vol. iii. part 2, p. 350,) I have the pleasure to forward several Inscriptions in the Cave-character, which I was so fortunate as to obtain from the Pipal Khora Monastery, and also from the large Vihara upon the Baitalbari plateau. The whole are much defaced, but still I hope enough remains by which the general sense may be made out. I have also enclosed several others, taken by me on a late tour. The three long ones in the Balbodh character were unearthed by me from the ruins of an old temple at Bagli, in Kandish: the deity originally worshipped was Mahadeo, but at present it is occupied by Mangboas, who have devoted it to Krishna. The inscriptions were coated over with mud and white-wash. Though the Pundits to whom I have had an opportunity of showing these inscriptions are able to read the character, they cannot render the sense of it.

I would have forwarded some plans and drawings of the caves I have described, but having made them on a large scale, I must defer doing this for a few days, until I have adapted copies of them to the size of the Journal.

### CAVE-TEMPLES OF BAITALBARI.

The first to be described occurs about 18 miles west of Ajunta, and near the once important fortress of Ousaghur. It lies shut out from the world in a *cul de sac* of the mountains, amidst deep narrow ravines, embowered in thick wood jungle, and with great difficulty approached, from the falling of the scarped frontage having buried under its *debris* the path leading to it. The table-land may here be, perhaps, 800 feet

above the lowlands of Kandish, lying at its feet: the caves occur about two-thirds the way down.

The first to be noticed is a fine Vihara cave, 80 feet square, with a general plan similar to the northern caves at Ajunta. It is called by the natives the abode of Guttoor Duz, and consists of an outer veranda, a central hall, with colonnade of boldly sculptured pillars; side aisles, into which recessed chambers and cells open; and a sanctuary, with vestibule, and side chapels.

The outer veranda has partially fallen; its length is 80 feet, and breadth 17 feet. The extremities are terminated by chapels, being chambers 13 feet square, with vestibules supported by two pillars, and two pilasters in antis. That upon the western side is much choked up with mud, and from the water collecting in that direction during the rains, the sculpture has become defaced. Upon the eastern side, the pillars are in good preservation: they are richly ornamented, having fluted shafts and amphoral capitals with clustering leaves pendant at either angle of the abacus. Bands of rosettes, chain-work, and drapery encircle the shaft. In a small recess of 2 feet square at the western side, there is an inscription in the old Cave-character. The words have been cut in the rock, and subsequently coated with fine stucco: the vowel points in many places appear to have been painted. Unfortunately the inscription, from its exposed situation, has become much eroded, leaving but a very small portion that can clearly be made out.

The outer veranda is pierced by five doorways, leading into the hall. The centre one is the most ornamented: its jambs are decorated with double figures, and scrolled floral designs, with a double frieze above, full of compartments, containing sculpture tolerably executed. The subjects are various: several represent Buddha in different positions of abstraction, and in one his attendants are snake-hooded, and bear vessels upon their shoulders. One group struck me as remarkable, from having noticed a *fac-simile* of it upon the walls in the hall of the Indra Subbha, at Ellora. It represents a female reclining in pensive mood upon a couch, gazed upon by a male figure from behind. The other groups have nothing particular to tell their tale: horsemen, carriages drawn by horses, and footmen, occurred; with elephants and crocodiles mixed up in the decorative designs of the frieze.

The two doors next the central one are plain, but the outermost have ornamented frieze work and sculptured figures on the jambs. The character of the sculpture above the door is the varied positions of Buddha in holy meditation, seated in temples with melon-shaped domes.

The hall, including the surrounding colonnade, measures 80 feet square. Twenty pillars support the roof, 13 feet high, and 3 feet 3 inches in diameter at the base, but something less at the upper part, which gives them an Egyptian air of solid grandeur. They have square pediments, and octagonal shafts, with bracket capitals. The four central pillars differ slightly from the rest, in having the shaft breaking from eight into sixteen sides. The aisles or colonnades surrounding the hall are 12 feet broad; those on the east and west sides are alike, and contain each a central recessed chamber, with two pillars and two pilasters in antis, and two cells 9 feet square on either side of the centre recess.

The south aisle, or inner veranda, has its eastern end closed by a cell; upon the west there appears a recess, and cell leading from it. Around the walls of the recess are ranged compartments, in which standing and seated figures of Buddhas and Bodiswatas appear, with several deghopas in high relief. One upon the north side is larger than the rest, and extends from the floor to the ceiling. A niche in the front of its basement contains a seated Buddha, holding up in his hands what appear to be the leaves of a scroll. Excepting a cross-legged seated Buddha cut upon one of the pilasters at the western side, no more sculpture is seen within the hall.

The northern aisle contains the vestibule and sanctuary, with side chapels. The pillars and pilasters of the vestibule are in design similar to those of the hall, and placed in antis. Within, two gigantic Bodiswatas stand beside the sanctuary door, as doorkeepers; the doorway is well proportioned, being 9 feet 6 inches high and 4 feet 3 inches broad. The jambs are ornamented with double figures in caressing attitudes, associated with floral running patterns.

The sanctuary contains Buddha seated on the Sinhasan, with the wheel in front, and antelopes below: his attitude is that in which the point of the right thumb meets the upper part of the left little finger. The height of the idol is colossal, measuring 8 feet 6 inches in his sitting posture. Two gigantic Bodiswatas, similar to those standing without, are in attendance right and left of the throne.

The chapels on either side of the sanctuary contain no sculpture. They are 9 feet square, and supported by two pillars and two pilasters.

I am inclined to believe that sculpture of much importance once decorated the entrance of this cave, judging from the remains of a very handsome colossal figure lying half buried close beside the outer veranda. The roots of the *Sterculia* and *Boswellia* have loosened and detached large masses of the hill-side, precipitating them into the

ravine below, and very probably blocking up the entrances to other caves. This sculpture is similar in style and character to the snake-hooded figures observed right and left of the porched entrance to Koilas at Ellora. My conjecture as to other caves being hidden under the talus of the hill arises from the circumstance of the rains a few years back washing away a portion of the slope some thirty yards north of this cave, and exposing the entrance to a vihara 21 feet square, supported by four pillars, and two pilasters.

In the hill-side of the opposite ravine I observed two or three openings, as if of caves : they looked exceedingly well at this distance, and I promised myself a grand treat, especially as I was assured by my guide that no *sahib logh* had ever seen them, and that they were full of idols. Moreover, the depth of the excavation was so enormous, that nobody had yet got to the end of it ! It required certainly some such stimulus to surmount the toil, and not a little danger, attending the scramble up that steep ascent. My mortification was proportionately great on finding all my labour had been taken in vain ; and that I might congratulate myself if I got down again without breaking my neck, the openings proving to be nothing but the commencement of a cave.

### VIHARA CAVE AT BAITALBARI.

The fort of Baitalbari is perched on the summit of an isolated hill, looking over Kandish : in the northern front, close under the walls of the fort, a vihara cave is excavated 26 feet long, and 24 feet broad, supported by four square pillars, and four pilasters, in two rows. There is no decorative sculpture nor idol.

### CAVE IN THE GUNISHA KHORA, NEAR THE FORT OF BAITALBARI.

This cave is dug at the head of a very romantic-looking glen, two miles east of Baitalbari ; a water-fall, trickling down the scarp all the year round, flows into a natural cistern that has been hollowed out of the rock, and evidently has been the inducement for making this spot the site of the cave-temple. It consists of a hall, divided into two chambers, with passages, out of which cells lead. Several small square excavations outside appear to have been shrines of some kind or other.

The natives call the cave the temple of Roodera Soor. Rude steps cut in the sheet rock lead by the edge of the cistern to the entrance, partly built, and partly tunnelled in the rock. It has two doorkeepers, 5 feet high, at the inner entrance. A cell opens right and left into the

passage. From the inner door to the hall there is a covered way, or veranda, in which are two cells or dormitories.

The hall is divided into two chambers by a bench, which also runs round their sides: the northern chamber is raised two steps from the southern one, and has been altered from the original plan, by building a chaboutra level with the benches, and placing on it the linga and the bull Nundee. The southern chamber contains a large figure of Gunputtee, rejoicing in a brilliant display of red-lead and oil, supported on his left by a sculptured representation of Veer Budra piercing the Dyot, and by Narsingha on his right, destroying Harsingha. Niches are cut in the rock upon the three sides.

### BUDDHIST CAVES NEAR THE FORT OF KUNNAIRA, IN THE PIPAL KHORA.

In a sequestered part of the hills some 14 miles west of Kunnur, and 2 or 3 from the Jooneeree Pass, a rather important series of Buddhist caves are found. Their situation is so completely retired, that the guides who showed me the way had some difficulty in hitting upon the right path. They are situated in the scarped sides of the head of a ravine, which, rising broadly in the Kandish valley, gradually contracts its sides as it rises the table-land, until it terminates in an abrupt cliff-like slope. As the site is viewed from the opposite side, the caves are seen to have had two stories, the remains of galleried chambers still existing in the face of the rock, and which were formerly in communication with the caves below by stair-cases tunnelled in the rock; these have all tumbled down the face of the hill, and half buried the entrance to the caves beneath their ruins.

The principal cave is the chaitya, the front of which has fallen with the caves above, exposing in a conspicuous manner its vaulted roof. It measures 85 feet from the fallen scarp to its further end, and 36 feet across from wall to wall. The nave, judging from the roof, has had thirty-five pillars, separating it from the side aisles. There are now but twenty visible, some of which have half fallen. They are octagons, without sculpture, but covered with stuccoed paintings of full length figures of Buddhist saints in long white tunics, and of all complexions, white, red, brown, and black. After considerable search, I was enabled to discover two inscriptions, which I copied as accurately as I could, the pale colour of the writing rendering them very illegible.

The roof has evidently been spanned by wooden ribs, which have disappeared, but left a discolored mark in the stucco, the ceiling having

been painted: holes are sunk in the rock, at the termination of these marks, evidently to receive the fastenings of the frame-work, which is the case also around the lower part of the walls of the nave, just immediately above the pillars. Mortices of larger dimensions are visible at the circular part of the nave to receive the tenoned machinery of the deghopa.

The deghopa, though apparently a very solid structure, lies shattered in fragments upon the ground: the base measures 12 feet in diameter. Its destruction has been evidently the work of a licentious bigotry.

The side aisles have a vaulted ceiling, and stone ribbings, the whole covered with stuccoed paintings of Buddhist saints, seated on lotus thrones, under triple umbrellas, with long white fringes: some have boys with shaved crowns kneeling before them. The drawings are good, and appear to have been executed with facility. The wall for about 4 feet from the ground is built up, owing to a defect in the strata of the rock. No inscriptions were found.

At the eastern side of the entrance there are three cells, with stone benches. An aperture in the broken rock half way up the side shows the tunnelled passage that led to the galleried chambers above.

Upon the west of the chaitya there are four viharas, and one upon the east. The first westward has the front fallen in, and much choked with broken rock. It contains sculpture of quite a novel and peculiar character, something similar in design to the monasteries of Cuttack, in the horse-shoe niche, and reeded string courses, but differing in other details. The hall measures 48 feet in length, and 23 in breadth: cells open into it on three sides. Originally it would appear that the roof had been supported by 12 pillars, and as many pilasters: there are but now the remains of four pillars, and ten pilasters.

The northern side has seven cells, each with a door and lattice, the latter being made to represent lacing of ropes, or reeds. Over each door, occupying the whole front, is a horse-shoe niche, and between each doorway stands a pilaster, with square basement, and octagon shaft, surmounted by a cushion-shaped capital, formed, as it were, of reeds bound together by cords, the whole yielding, apparently, to pressure.

The capitals support winged animals, arranged in pairs back to back, $1\frac{1}{2}$ foot high. They consist of maned lions, wolves, nondescript animals armed with claws and maned, but having heads like camels, horses, elephants, and centaurs. These winged figures are in good taste, and executed with much spirit. The peculiar style which characterises the sculpture is, I conceive, a subject of curious inquiry

as to whether the artist had derived his ideas from the banks of the Tigris or not.

Inscriptions in the old Cave-character are cut upon the wall over each lattice, but much defaced by the crumbling nature of the rock. The cells have vaulted roofs, with stone ribs, like the chaitya often possesses, and benches running round the walls: their dimensions are 8 feet long, and 7 feet broad. The east and west sides have three cells, like the centre ones, but the whole are much destroyed. An aperture in the east side, 6 feet square, led to the caves above, and there is also another dark tunnel leading out of the corner cell of the north side, up to the same outlet. The pilaster by the door of this cell differs from the rest in the animals upon the capital being without wings: they are bulls.

A doorway in the centre of the western wall opens into a large chamber 34 feet long, and 22 feet broad. Cells are ranged all round, but their fronts have fallen, and blocked up the cave. The entrance towards the Khora is quite choked up by fallen fragments of the scarp.

Two more viharas are found some short distance beyond; they are *fac-similes* of each other, differing slightly in their measurement, one being 39 feet long, and 33 feet broad, the other 33 feet long, and 30 feet broad. Cells are ranged on three sides—five in the centre wall, and four at either side. Their dimensions are 8 feet 7 inches by 7 feet. They are provided with stone benches, and some have small square recesses in the walls. The smallest of the two caves has had most care taken in the general details, the central cell in the northern wall differing from the other, by being ribbed and vaulted within, like the chaitya.

There remains one more excavation to be mentioned, situated east of the chaitya, and appears to have been abandoned after the general plan had been considerably advanced, probably from a defect in the rock, for a stratum of slatey trap, or decomposed phonolite, here occurs, to the depth of three or four feet, splitting into fragments on the slightest force being applied, and peculiarly ill adapted for purposes of extruction. The length is 110 feet, with a depth of but 24 feet. The ceiling and walls thus far are smoothed and finished: here and there side cells have been commenced upon, but so much rubbish, principally slatey fragments of phonolite, have fallen in, that it is difficult to say what has been intended.

It is remarkable, that amongst these caves no sculptured figure of Buddha appears, nor any emblems of the faith, beyond the large

deghopa: this would argue something for their antiquity. The only sculptured human figures seen, very mutilated, are high up in the scarp, at the spot where the galleries have fallen: they consist of a female standing behind a seated male figure. But the most remarkable circumstance is to be noted in the occurrence of *winged animals*. Their details are expressed with life and spirit—unusual with the conventualities of cave-sculpture in general. The forms of the wings are bold and graceful, and whether the types be derived from Assyria or not, the resemblance is sufficiently striking and extraordinary.

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## ART. VIII.—*Descriptions of some of the larger Forms of Fossilized Foraminifera in Scinde; with Observations on their Internal Structure.* By H. J. CARTER, Esq., Assistant Surgeon, Bombay Establishment. With a Plate.

Presented 11th November 1852.

THROUGH the kindness of several officers of the Bombay Army, access to the Society's Museum, and my own experience in Scinde, I have become acquainted with many, if not most, of the larger forms of fossilized Foraminifera of that country; and as descriptions of them may prove acceptable to those engaged in the study of geology in Scinde and elsewhere, I have much pleasure in offering them for publication in the Society's Journal, should they be deemed worthy of it.

I wish it had been in my power to point out the particular parts of the Nummulitic Series in which they are found, but as we are perfectly ignorant of all detail of this kind respecting Scinde, it must be left for future opportunity to develope.

In the description of these Foraminifera, I shall not confine myself to their external characters alone, for, generally speaking, this would be useless, but having studied them by sections, shall also allude to their internal structure, which, though already given most faithfully by Dr.

Carpenter (Quart. Journ. Geol. Soc. vol. vi. p. 21), yet there are some parts still incomplete, which I shall endeavour to supply, and some observations which can only be made intelligible when the forms of *Operculina, Assilina, Nummulina, Alveolina, Orbitoides,* and *Orbitolites* are considered together and described successively.

The distinguishing characters of these genera, familar, at least, in name, to all who are acquainted with the classification of Foraminifera in D'Orbigny's "Foraminifères fossiles du Bassin Tertiaire de Vienne," and in his "Cours élémentaire de Paléontologie et de Géologie Stratigraphiques," I shall here premise that the reader, if inclined to study them, may have no trouble in immediately referring to the same sources from which I have derived my guide.

## Order III. HELICOSTEGUES.

### Fam. 1. Nautiloidæ.

### Genus Nummulina, D'Orbigny.

"*Shell,* free, equilateral, orbicular or discoidal, thick, encrusted, without appendices at the border, formed of a *spire* embracing, with whorls very near together and numerous; the last always marked in the young animal, but often impossible to be found in the adult. *Chambers,* small, short, near together, very numerous, the last projecting in the young animal, but indistinct in old individuals; pierced by an opening, transverse, linear, against the turn of the spire, often concealed in the adult."

### Assilina, D'Orbigny.

"*Shell,* free, equilateral, orbicular or discoidal, very compressed, formed of a *spire* embracing only in the young animal. Afterwards whorls apparent, and without appendices at the border. *Chambers,* small, short, very numerous, the last projecting in the young animal, but not so in the adult, each pierced by an *opening* against the turn of the spire."

"*Relations and differences.*—The *Assilina,* like the Nummulines, have a projecting mouth when young; but they are distinguished by all the turns of the spire being apparent in the adults instead of being embracing.

### Operculina, D'Orbigny.

"*Shell,* free, equilateral, oval or discoidal, very compressed, formed of a *spire* not embracing, regular, equally apparent on both sides, turns contiguous, and increasing very rapidly. *Chambers,* numerous, narrow,

the largest projecting beyond all the rest, pierced at all ages by an opening which is visible, triangular, against the turn of the spire."

"*Relations and differences.*—It is evident, that by the situation of its opening, this genus comes near to the Assilines; but it is distinguished from them by its opening being triangular instead of a transverse slit; and by its chambers increasing regularly, without becoming narrow towards the opening."

ALVEOLINA, D'Orbigny.

"*Shell,* free, regular, equilateral, round, oblong, or elongated, in the direction of its axis, not variable in its enlargement, composed of a very regular *spire,* embracing at all ages; whorls often very near together, not formed of many chambers, elongated transversely, divided into a great number of capillary cavities by partitions longitudinal to the whorl, the openings round, numerous, and in lines tranverse to the whorl."*

CYCLOSTEGUES, D'Orbigny.†

"Animal composed of numerous segments placed in circular lines. Shell discoidal, composed of concentric chambers, simple or multiple; no spire."

"*Cyclolina,* D'Orb. 1839. Shell discoidal, each chamber pierced by a number of pores, making an entire circle round the rest."

"*Orbitolites,* Lamarck, 1801. (*Orbulites,* 1816, non *Orbulites cephalopodes.*) *Marginopora,* Quoy et Gaimard, 1836. Shell discoidal, plane, equal, and encrusted on both sides, presenting concentric lines. Chambers numerous in irregular transverse lines only visible at the border."

"*Orbitolina,* D'Orb. These are *Orbitolites* with unequal sides; the one convex, encrusted, presenting concentric lines; the other concave, not encrusted; presenting numerous chambers, in oblique lines upon the side at the circumference."

"*Orbitoides,* D'Orb. Shell discoidal, convex on both sides, formed of a single range of chambers, round the disk, very thickly encrusted about the middle, and presenting either radiating lines or granulations."

* Foram. Foss. du Bassin Tert. de Vienne, par M. Alcide d'Orbigny.

† Cours élément. de Paléontologie et de Géologie Stratigraphique, par M. Alcide d'Orbigny.

*Observations.*

To these characters I shall add the following observations before proceeding further :—

First, as regards the distinction between the genera *Assilina* and *Nummulina*. This is said to consist chiefly in the spire not being embracing in the former, and which appears to be the case to the naked eye. But if we make a vertical section of *Operculina*, which, from its extreme thinness, is still further removed from *Nummulina* than *Assilina*, it will be seen, under a magnifying power, to be formed of several layers, which may be traced from the centre to the circumference, showing, that as the turn of the spire is progressing, the deposition of new material not only takes place at the margin, but on both sides of the shell generally, in a line from the last chamber in process of development up to the central or first-formed one. If, then, this can be seen in a shell so thin as that of *Operculina*, how much more evident must it be under the same circumstances in *Assilina!* which is the case. D'Orbigny's grand distinction, therefore, of the spire not being embracing in *Assilina*, would seem to be more apparent than real, and although sufficient for common purposes, yet, if we add to it the *absence* of chambers above and below the central plane, we shall not only have a real, but a more evident distinguishing sign for *Assilina* than the one given by D'Orbigny.

Second, as regards the division of *Nummulina* into subgenera.

It appears to me that this may be advantageously done by separating those in which the septa extend from the circumference to the centre in more less continued sinuous lines (Plate II. figs. 11 & 15), from those in which the lines are so branched and inosculate as to present a densely reticulated structure (fig. 21).

Such differences have already been alluded to by Dr. Carpenter. (*Loc. cit.*)

In the latter subgenus would then come *Nummularia acuta?* Sowerby, which borders close upon *Orbitoides*, from possessing this reticulated structure on the surface, a comparatively less development of the spire and chambers, a tendency to an abrupt prominence in the centre, and an expanded thin margin.

From *N. acuta* we should then pass on to *Lycophris dispansus*, Sowerby, where the spire is still more incomplete, and then to *Orbitoides Mantelli* or *Orbitolites Mantelli* (for we shall see hereafter that we must make this an Orbitolite), where the spire is entirely lost.

In the last two genera I have been at much pains to ascertain if the

rows of chambers in the central plane are arranged spirally or concentrically, and I think that I have been as successful as, under the circumstances, we can expect to be.

For some time I was unwillingly obliged to yield to the opinion of D'Orbigny, that the rows of chambers commenced concentrically, for having taken adult specimens of *Lycophris dispansus* and *Orbitoides Mantelli* for sections, I found the centre in each species invariably filled with calc-spar, which, apparently, was surrounded by circles of chambers at its circumference, that is, where the latter began to appear. Hence I had given up almost all hope of being able to determine this satisfactorily, when I conceived that the origin of this structureless centre might be owing to a decay of the central chambers in the adult animals only, and its subsequent filling with calc-spar during fossilization; and, that, if I took very young individuals, I might obtain what I wanted. Accordingly, I made sections of specimens not larger than the 24th part of an inch in diameter, and found just what I had expected, viz. the centre in its natural state, that is, filled with chambers to the central point.

I will now shortly describe the central planes in both these species, reserving a more particular account of them until we come to the descriptions of the species themselves.

In *Lycophris dispansus* the central plane is extremely, though uniformly, thin throughout, and only one chamber deep. The chambers commence in an imperfect spire, round a central spheroidal or oval cell, not much larger than the chambers themselves generally. Around this cell are a few chambers which have—one a semilunar, and two or three the pear-shaped forms of the chambers commencing the spire in the nautiloid forms of Foraminifera (compare fig. 26. Pl. II. with fig. 8, Pl. xviii. vol. iv.); the rest are more or less polygonal. From these chambers (about seven in number) as many rows of others fly off from the centre in whorls similar to the sparks of a rotatory fire-work, but these rows soon diminish in breadth, and end more or less abruptly upon the back of each other; when another set rises from their circumference, which takes a larger latitude; and so on successively, a series of whorls or wreaths follow upon the back of each other, until the rows appear to form concentric circles, still every here and there dipping inwards, or suddenly terminating on the preceding ones, even to the circumference. This is the appearance presented by the central plane; but the real spire must be traced across the rows in the position that it would be in Foraminifera wherein it is more perfectly developed,—if, indeed, it be traceable at all.

In *Orbitoides Mantelli*,* however, the central plane is very different ; here it is not uniformly thin throughout, but thin in the centre and thick at the circumference, from the cells being only half the size in the former that they are in the latter ; they are also all spheroidal, or elongated vertically, and not quadrangular. When they are elongated vertically, this seems to depend on two or more running into each other in this direction ; hence the central plane, instead of being composed of only one layer of quadrangular chambers, as in *O. Mantelli*, is composed of a plurality of layers of spheroidal ones : this, together with the smallness of the central cells, their great similarity, and the whole plane which they compose being more or less wavy, renders it almost impossible in the section to detect the central cell itself, or to determine whether the others are arranged around it in concentric circles ; while it seems almost equally impossible to trace them in circles towards the circumference, to determine this, where their arrangement even is most distinct.

Hence it would appear that D'Orbigny is not warranted in giving the distinguishing character of concentricity to the rows of chambers in his order *Cyclostègues*, for in his three first genera, which are all alike in this respect, we have seen that it is almost impossible to determine this ; and in the last genus, viz. *Orbitoides*, of which *Lycophris dispansus* is a type, it is evident that it is not the case, but that the chambers are arranged subspirally.

That *Orbitoides Mantelli* should be included among the *Orbitolites*, and not among the *Orbitoides*, must also now be evident, from the striking differences that exist between it and *Lycophris dispansus*, and its identity in structure with *Orbitolites* generally ; while the intervening link between it and *Nummulina* is naturally supplied by *Orbitoides* bearing the characters above mentioned. It may be observed, that the cells of the central plane in *O. Mantelli* are elongated, and not spheroidal, but the one seems to be as constant as the other, and the elongation vertically only to depend, as before stated, on the thinness above and below of the walls of the cells forming the central plane, which renders those parts imperfect or imperceptible in the vertical section, and makes the cells appear to run into one another ; while the opaque material or intercellular substance showing out at their sides gives them that septal, and at the same time quadrangular form, which approximates the whole central plane in appearance to that seen in the vertical section of *Orbitoides* and *Nummulina*.

* Quart. Journ. Geol. Soc. vol. vi. p. 30.

There are several other observations which I have to make on the structure of these two genera, but they will be better understood in connection with their species when respectively described.

As the list of synonyms of the discoidal Foraminifera already described is very great, for the short time they have become interesting,* at the same time that their descriptions are very few, and not within my reach, I shall avoid as much as possible introducing new names here, in hope that others who are more favourably situated may be able to do this from my descriptions and figures, if required, or that I may be able to do it myself at some future period, when I have better means of comparing the specimens of different localities than I at present possess. Meanwhile, as so little has been done in the subject, I am not without hope that that which I have now to offer may be found useful.

In order of description I shall not exactly follow D'Orbigny's arrangement, that I may be the better able to show the transition from the simple to the more complicated forms of discoidal Foraminifera. Thus, I shall place *Operculina* before *Nummulina*, &c., *Alveolina* after *N. obtusa*, Sowerby, and before *N. acuta*, id.; and then pass on to *Orbitoides* and *Orbitolites*.

The figures in the Plate are intended to represent the largest specimens of the species I have met with respectively; and where the characteristic structure externally has been too minute to be seen by the naked eye, a small portion has been magnified in the centre. Indeed, in almost all, the lines and makings are larger than they are naturally, and are therefore represented as seen under a magnifying glass of low power, for in no other way could these characters be given.

As a typical description of *Operculina* and the structure of foraminiferous shells generally, I must refer the reader to my observations on *O. Arabica*, published in vol. iv. No. xvii. of this Journal, by a perusal of which an understanding of what follows will be much facilitated.

### OPERCULINA, D'Orbigny.

1. *Operculina inæquilateralis.* (H. J. C.) Inequilateral, oval or discoidal, thin, horizontal or wavy; centre prominent, margin thickened, rounded, cord-like. Spire more or less irregular, more apparent on one side than the other, consisting of three whorls, concave on one side, flat on the other, increasing rapidly from a central cell. Chambers

* See Murchison on the Structure of the Alps. (Quart. Journ. Geol. Soc. vol. v. p. 309.)

numerous, narrow, slightly reflected. Septa reflected, more apparent on one side than the other. Diameter of largest specimens 5–24ths of an inch (Plate II. figs. 1, 2).

*Loc.* Muskat, in Arabia.

*Obs.* This species differs a little from D'Orbigny's characters in being inequilateral, but the difference between the two sides is so slight that it cannot be referred to any other genus. The intercameral communication I have not been able to make out, and although D'Orbigny almost invariably gives its shape and position in the nautiloid Foraminifera as a distinguishing character, yet I have hardly ever been able to see it satisfactorily in any of the species that I have examined.

*O. inæquilateralis* is a characteristic fossil of a thick, pink-coloured, silico-calcareous, sandy stratum at Ras Ghissa, the first little cape south of Muskat, which is a port on the north-eastern coast of Arabia opposite Scinde. I have inserted its description here chiefly for the purpose of commencing with the simplest form of nautiloid Foraminifera, and also from its proximity in locality to Scinde.

2. *O.* ——*?* Equilateral, discoidal, plane or slightly wavy, thin. Centre prominent, and presenting granulations or small tubercles, projecting more in the young than in the adult state; tubercles, situated over the septa, one to each; margin slightly thickened, rounded, cord-like. Spire more or less regular, equally evident on both sides; consisting of six whorls, gradually increasing to the last, which is 1–24th inch broad; each whorl over-lapping or embracing, with its internal border the external margin of the preceding one, which is rounded and cord-like. Chambers numerous, reflected; septa reflected, apparent on both sides. Diameter of largest specimens 5–12ths of an inch; thickest part, which is the margin, 1-36th of an inch (figs. 3, 4).

*Loc.* Scinde; in company with *Alveolina*, near the town of Tatta.

*Obs.* In this species, which is twice the diameter of the last, and generally more horizontal, the whorls are more numerous, and the spire increases more gradually. I could not discover the intercameral communication.

### Assilina, D'Orbigny.

1. *A. irregularis.* (H. J. C.) Equilateral, discoidal, more or less wavy, compressed, thin. Centre depressed, margin thickened, rounded, cord-like. Spire more or less irregular, projecting on both sides, excepting in the centre, where it is nearly obscured; consisting of nine whorls, increasing gradually towards the penultimate, which is 1–12th inch wide; each whorl overlapping or embracing, with its internal

border the external margin of the preceding one, which is thickened, rounded, and cord-like throughout the spire. Chambers subquadrangular, oblong, irregular in size, presenting a number of minute granulations over their surface externally. Septa straight, radiating, and a little reflected, evident on both sides, except in the centre. Diameter of largest specimens 11–12ths of an inch; thickest part, which is the margin, 1–24th of an inch (figs. 5, 6).

*Loc.* Scinde.

*Obs.* This, although somewhat resembling the last-described species of *Operculina*, differs from it in being much larger and coarser in form, in the extreme irregularity of its spire and development generally, the depression in the centre, the obscurity of the three first whorls, and in the penultimate whorl being the broadest. I could not discover the intercameral communication.

2. *A.*——*?* Equilateral, discoidal, slightly wavy, thick, smooth, depressed in the centre, angular at the margin, presenting broken curvilinear lines on the surface with minute granulations between them, arranged in a spiral form, radiating from the centre, indicating the position of the spire and septa. Internally whorls more or less wavy, more or less irregular in breadth, the largest between the centre and the circumference (2–48ths of an inch broad); about nineteen whorls may be counted within half an inch of the centre. No chambers above or below the central plane. Diameter of largest specimens 1½ inch; thickest part, which is between the centre and the margin, 3–12ths of an inch (figs. 7, 8).

*Loc.* Scinde.

*Obs.* This closely approaches *Nummulina* from its size and thickness: the spire and septa, however, are still more or less visible exterally, but the increased thickness of the shell obscures their prominence, and gives the surface more smoothness and uniformity. The edge is thick and angular, instead of being round and cord-like, as in the forgoing species, and the whole now closely approximates a Nummulite.

NUMMULINA, D'Orbigny.

1. *N.*——*?* Equilateral, discoidal, more or less wavy, thin, gradually diminishing in thickness from the centre towards the margin, presenting on the surface numerous small papillæ or granulations, between sinuous lines running more or less irregularly from the centre to the circumference, the latter being the most evident of the two in the young shell. Internally whorls more or less wavy, more or less irregular in breadth; the widest between the centre and the circumference (2—48ths inch

broad) : about twenty whorls may be counted within half an inch of the centre. Compressed chambers above and below the central plane. Diameter of the largest specimens $2\frac{4}{10}$ inch ; thickness in the centre 2-12ths of an inch (figs. 9, 10).

*Loc.* Scinde.

*Obs.* The great point of difference between this and the last-described species of *Assilina* is the presence of the compressed chambers above and below the central plane in the former. The whorls here, therefore, are evidently what are termed embracing, and the centre is prominent on both sides instead of being depressed. This Nummulite attains the largest size of any species that has come under my observation.

2. *N. millecaput?* Equilateral, discoidal, more or less wavy, thick, angular at the margin, presenting sinuous lines on the surface in close approximation, which extend from the circumference to the central prominence on each side, presenting a series of superficial whorls in the adult animal. Internally turns of the spire very numerous, more or less wavy and irregular in breadth, the widest between the centre and the circumference 1-48th of an inch broad; about forty-eight whorls may be counted within half an inch of the centre ; compressed chambers above and below the central plane. Diameter of the largest specimens $1\frac{6}{10}$ inch ; thickness in the centre 3-12ths of an inch (figs. 11, 12).

*Loc.* Egypt.

*Obs.* This differs from the foregoing species in its general thickness ; the number and approximation of its sinuous lines, the absence of the small granulations or papillæ between them, and the greater number and narrowness of its whorls. The sinuous lines, although confused, and in whorls all over the surface in the adult animal, are nevertheless distinctly sigmoid in the young one, running from the circumference to the central prominence of the shell on both sides.

This specimen was brought from Egypt. It appears to be *N. millecaput*. That figured by MM. Joly and Leymerie is $1\frac{1}{4}$ inch in diameter. Generally the *Nummulites* of this kind from Egypt which I have seen (those of the Pyramids to wit) have been about an inch in diameter, and about 2-12ths inch thick. I have inserted its description here, and figure in the Plate, for the sake of comparison, not having met with one of exactly the same kind in Scinde.

3. *N. obtusa*, Sowerby. Equilateral, more or less globular, compressed in the centre, obtuse at the margin. Surface presenting sinuous lines in close approximation, and in confused whorls in the

adult animal, but simple and sigmoid in the young shell; extending from the septa at the circumference to the central prominence on each side. Internally whorls numerous, the broadest between the centre and the circumference; lines of the spire nearly as widely separated above and below the central plane as they are in the central plane itself. Chambers numerous, reflected; septa reflected. Diameter of the largest specimens 11-12ths of an inch; thickness 2-10ths; number of whorls thirty-three (figs. 13, 14).

ALVEOLINA, D'Orbigny.

1. *Alveolina melo*, D'Orb. (*Melonites spherica*, Lamarck.) Spherical, equilateral, presenting longitudinal lines, which extend in a sigmoid form from apex to apex, and minute transverse parallel ridges between them, marking corresponding internal divisions of the chambers. Internally chambers fusiform, sigmoid, divided into hair-like spaces by transverse septa, which are the continuations of the ridges mentioned; the whole arranged in a spiral form. Diameter 5-24ths of an inch (fig. 15).

*Loc.* Scinde, Arabia.

2. *Melonites spheroidea*, Lamarck (fig. 16).

*Loc.* Scinde, Arabia.

*Obs.* This has the same characters as the last, with the exception of being larger, and a little elongated. Longest diameter 7-24ths of an inch; transverse diameter 6-24ths. Abounds about Tatta in Scinde, where it is well known by the name of "tomra," and is made into strings of beads for Hindu pilgrims, and others of the Hindu faith. They are said to be prepared for this purpose by being repeatedly struck with a hammer, until the external layers, peeling off, leave a smooth surface.

3. *Fascicolites elliptica*, Parkinson (fig. 17).

*Loc.* Scinde.

*Obs.* This also has the same characters as the foregoing species, but is much elongated, almost cylindrical. Length 7-24ths of an inch; breadth 3-24ths. It abounds about Hydrabad, and near the Buran river, in company with a discal Orbitolite, to be hereafter described.

There is nothing to distinguish these species one from another but their spherical, spheroidal, and elliptical forms respectively. The two latter appear to have their peculiar localities in Scinde, and to be sparingly mixed together. On the south-east coast of Arabia, where they are also found in company with discal *Orbitolites*, the spheroidal form is most common. D'Orbigny has made them the last genus of his

second section of nautiloid Foraminifera, but I have inserted their description here, to show the transition from the flat to the elongated forms of his *Helicostègues*.

Let us now return to the descriptions of the other *Nummulites*, which will be found to differ from the foregoing in the absence of the sinuous lines on the surface, and in the presence of the reticulated structure mentioned.

NUMMULINA, D'Orbigny. (Subgenus.)

4. *Nummularia acuta?* Sowerby. Equilateral, discoidal, wavy; centre rather abruptly prominent, margin thin, acute; surface presenting a subgranular, reticulated structure, the interstices of which tend to a spiral arrangement towards the circumference. Internally consisting of a thin central plane of chambers arranged in a spiral form, with layers of compressed ones above and below it. Whorls numerous. Chambers three times as long as the whorl is broad. Septa straight, or but slightly reflected; each chamber divided into three or more reticulate divisions by sub-septa, which structure, extending from the circumference to the central prominence, gives the surface the reticulated appearance mentioned; each interstice corresponding to a compressed cell, which is the external extremity of a columnar pile extending down, more or less regularly, to the central plane. Diameter of largest specimens 7-12ths of an inch; thickness in the centre 3-10ths (figs. 21, 22).

*Loc.* Scinde.

*Obs.* This appears to be *N. acuta*, Sowerby, (Grant's Geol. Cutch, *loc. cit.*) from its subgranular surface, size and shape. I do not know any other species like it in Scinde, if this be not the one. There is another species (figs. 19, 20) of this character which abounds in the nummulitic rocks at the island of Masira, on the south-east coast of Arabia, but this appears to be *N. Garansiana*. (Joly et Leymerie, Mém. sur les Nummulites, pl. 1, figs. 9-12.) It is also subgranular on the surface, and presents the reticulated structure of the species just described, but with a tendency to radiation in its lines, which approximates it to the *Nummulites* of the first class, and therefore its place here should precede *N. acuta*. Its diameter is 9-24ths of an inch, and its thickness 3-24ths of an inch.

The reticulated structure on the surface, while it characterizes this subgenus of *Nummulina*, also allies it strongly to *Orbitoides*. Another character which distinguishes *N. acuta* from the foregoing species is the greater length of the chamber being in the direction of the spire,

instead of across it, and its subdivision into reticulate ones, which, with the thinness of the central plane, implies a commencing disappearance, or imperfect state, of the latter generally; it is also more abruptly prominent in the centre, and thinner and more expanded in the margin. All this, while it separates *N. acuta* from the *Nummulites* of the first class tends towards the structure of *Orbitoides*, in which the chambers of the central plane are arranged subspirally. The lines, too, which are seen descending, in this as well as in other discoidal Foraminifera, to the central plane, are but the opaque matter filling up the interstices between the reticulate chambers; and in the midst of which are situated the interseptal vessels, which pass down to the central plane, and ramify throughout the shell.

## CYCLOSTEGUES, D'Orbigny.

### ORBITOIDES, D'Orb.

1. *Lycophris dispansus*, Sowerby. (Grant's Geol. Cutch, *loc. cit.*) Discoidal, wavy, more or less equilateral, centre abruptly prominent, margin expanded, and excessively thin and fragile at the edge; surface subgranular or tuberculated, especially over the central prominences; tubercles round, irregular in size and shape, united together by stellate lines. Internally presenting an extremely thin plane of quadrangular chambers, compressed vertically, oblong, and arranged subspirally, with their long axis in the direction of the horizontal diameter of the shell. Compressed chambers above and below the central plane, arranged in successive layers, like those of *Nummulites*, and more or less over each other, so as to form columns, which radiate more or less regularly from the central plane to the periphery, and end in the tubercles before mentioned. Diameter of largest specimens half an inch (figs. 23-29).

*Loc.* Scinde, Cutch, and Arabia.

*Obs.* I have already stated that the chambers of the central plane (fig. 24) of this genus commence from a central cell. This cell is spheroidal or elliptical, and perhaps a little larger than the generality of those which succeed it; the next formed is semilunar, and then comes a pear-shaped chamber or two; after which, the rest, that are in contact with the central cell, are more or less polygonal. From each of these chambers comes off a line of others in a spiral form, which, diminishing abruptly in breadth, terminates upon the back of the preceding one, the first being the shortest; to this succeeds another series of lines or rows, terminating in like manner, but of wider extension; and so on successively, until the plane, as before stated, appears

to be formed of concentric circles. Sowerby's account and figures of the external and internal structure of this fossil (*loc. cit.*) accord with my own observations; but Dr. Carpenter, (Quart. Journ. Geol. Soc. *loc. cit.*) I think, has been misled in considering the pillars of Sowerby "nothing more than the opaque matter filling the perforations;" since by a proper section these columns are seen, as before stated, to be the piles of compressed cells (fig. 29), as they ascend from the central plane surrounded by the "opaque matter" to the periphery. It is in this "opaque matter" that Dr. Carpenter's "perforations" are situated, that is, in the interseptal or intercellular spaces, which it partially fills; his perforations being the orifices of the interseptal vessels described in the structure of the shell of *Operculina Arabica*. (*Loc. cit.*)

In this species of *Orbitoides* we have the "stellate lines" uniting, or as it were supporting the columns of the cells. They consist of bars or vertical septa of opaque matter extending from one column to another, in straight lines, but diminishing in thickness towards the central plane, where they become faint and at last disappear altogether. They form the only distinguishing character between this species and *Orbitoides Prattii* (see illustrations to Dr. Carpenter's paper, *loc. cit.*); yet I am pretty sure that I have seen them in a section of the latter, near the central plane (where of course they were not present on the surface,) just as they are represented in fig. 14 *b* of Dr. Carpenter's illustrations, which this author regards as a feature of an undescribed species. Hence I am inclined to the opinion that *Lycophris dispansus* and *Orbitoides Prattii* are but varieties of the same fossil.

I should also here mention, that when the central plane of *Lycophris dispansus* is ground down to an extreme thinness, an interseptal space appears between the septa and an opaque line in the centre of it, indicative of the former existence of an interseptal vessel there, as in *Operculina* and *Nummularia*: this is also seen in Dr. Carpenter's illustrations (fig. 34).

2. *Lycophris ephippium*, Sowerby. (*Loc. cit.*)

*Loc.* Cutch.

*Obs.* Of this fossil Mr. Sowerby states: "These two fossils [*Lycophris dispansus* and *L. ephippium*] may possibly be different stages of growth of the same species," which seems to me very probable.

3. *Orbitoides Prattii*.

*Loc.* Scinde, Cutch, Arabia.

*Obs.* I have just stated the reasons which induce me to think that this is merely a variety of *Lycophris dispansus*.

ORBITOLITES, D'Orbigny.

1. *Orbitolites Mantelli.* (H. J. C.) *Nummulites Mantelli,* Morton. (Quart. Journ. Geol. Soc. vol. iv. p. 12.) *Orbitoides Mantelli,* D'Orbigny. (*Ib.*) Discoidal, wavy, equilateral or inquilateral; centre abruptly prominent on one or both sides, margin more or less expanded, very thin, plane or wavy, more or less obtuse at the edge; surface smooth, subgranular or tuberculated, especially over the prominent portions of the centre; tubercles minute, round, irregular in size and shape. Internally presenting a central plane, thin at the centre, thick at the circumference, composed of spheroidal or elongated cells, small in the centre, large at the circumference, placed in rows which appear to have a concentric arrangement, but this is indeterminable; cells alternate in adjoining rows. Compressed chambers above and below the central plane, arranged in successive layers like those of *Orbitoides* and *Nummulites,* more or less over each other, so as to form columns which radiate from the central plane to the periphery, where they end in the granulations or tubercles mentioned. Diameter of largest specimens half an inch (figs. 30, 31).

Figs. 32, 33, 34 appear to be merely varieties in form of the same species.

*Loc.* Scinde, Arabia.

*Obs.* This fossil, though at first sight almost identical with *Orbitoides,* is nevertheless on minute examination strikingly different. 1st. It is for the most part inequilateral, which at least is the opposite with *Lycophris dispansus;* its surface also is smoother from the granulations being more minute. 2nd. The central plane is thin in the centre and thick at the circumference; in *Orbitoides* it is extremely and uniformly thin throughout. 3rd. It is composed of a plurality of layers of spheroidal or elongated cells (figs. 36, 37); in *Orbitoides* it consists of a single layer of quadrangular cells (fig. 27). 4th. The cells are very minute and confusedly arranged in the centre; in *Orbitoides* they are as large in the centre as at any other part, and distinctly arranged. All this, while it tends to separate *Orbitoides Mantelli,* D'Orb., from *Lycophris dispansus,* which is a type of the genus *Orbitoides,* approximates it just as much more to *Orbitolites;* hence my reasons for changing its name.

The subgranular or tuberculated form which this species, as well as *Lycophris dispansus,* presents externally, arises from the extremities of the columns of compressed cells projecting above the surface, increased sometimes, probably, by the intercellular substance having been worn

or dissolved away; but this is not the case towards the circumference, on account of the columns being shorter, more vertical, and therefore nearer together, which of course renders the intercellular space smaller.

The septa seen in a vertical section of the central plane consist of opaque matter, which surrounds the columns, and as the latter end more or less in pointed extremities upon an imaginary central plane, we often see those of the opposite side interknitting with them, and the chambers of the centre of the plane assuming a triangular shape (fig. 39); sometimes they are quadrangular, and the septa continuous across the plane (fig. 38); at others they are oblong vertically, and curved a little outwards, like the septa seen in a vertical section of the central plane of *Nummulites*, which is their common form towards the circumference (fig. 36); while, just as often, the central plane is composed of two or three layers of spheroidal cells entire (fig. 37); from which I am inclined to infer, that where the other forms appear, it is merely from the cells running into each other vertically, and their parietes in this direction disappearing partially or altogether. In examining a vertical section of this plane, we frequently observe that every other space is a septum, and not a cell: this is owing to the cells being arranged alternately in adjoining rows.

2. *Orbitolites* —— *?* Equilateral or inequilateral, discoidal, patulous, more or less wavy, gradually diminishing in thickness from the centre, which projects a little above the general surface, to the margin, which is thin, though more or less obtuse at the edge. In other respects the structure of this is the same as that of the last species described. Diameter of largest specimens 2 inches; thickness 3-24ths of an inch (figs. 40, 41).

*Loc.* Scinde.

*Obs.* The great points of difference between this and the last species are, that it is not abruptly prominent in the centre, and diminishes gradually to the margin. It also attains a far larger size; and, as Dr. Carpenter has remarked, *loc. cit.*, sometimes "seems, instead of being a circumscribed disk," to have spread itself irregularly in every direction. The latter character is not more peculiar to it, however, than to the foregoing species.

From its frequent deep, patulous and wavy form, too, the horizontal sections of this Orbitolite in the matrix in which it may be imbedded often indicate a stellate, or other complex figure, which, however, is not the case; for with the exception of the foliaceous extension men-

tioned, it seems almost always to be discoidal. It is sometimes thicker on one side than the other, like the last species, but tends more to a horizontal than a vertical development, and therefore more nearly approaches the species about to be described, which is altogether discal, and without any incrustation on either side, being representative only of the central plane of this and the last species.

D'Orbigny's genus *Orbitolina*, in which there is an incrustation on one side only, I have not yet seen, unless fig. 33 be considered a species, where one side is plane and the other convex; but this, I think, may be a variety in form of either of the foregoing species, for, after all, it has an incrustation of compressed cells on the plane side, although not prominent. That species I consider to have no incrustation where the so-called central plane comes to the surface.

### CYCLOLINA, D'Orbigny.

1. *Cyclolina pedunculata.* (H. J. C.) Inequilateral, discoidal, smooth, thin in the centre, with a small papillary eminence on one side; thick at the margin; presenting concentric circles on the surface, alternately raised and depressed, with cells arranged circularly, which are hardly visible to the naked eye (fig. 42). Cells small in the centre, enlarging towards the circumference, spheroidal interiorly, elongated at the surface (fig. 44), arranged in circular rows alternate in each row. Diameter of largest specimens 10-12ths of an inch; thickness at the margin 1-48th of an inch (Pl. II. figs. 42, 43).

*Loc.* Scinde.

*Obs.* This is, as it were, nothing but the central plane of the foregoing species; that is, its development rests here, there being no incrustation on either side, and no compressed cells above or below the disc. I have called it *pedunculata* from the little papillary eminence in the centre on one side, this being constant in the few specimens I possess.

Thus we have passed, in description, from the simple nautiloid form of *Operculina*, in which the spire and septa are all visible exteriorly, to *Assilina*, where they are more or less obscured in the centre; thence to *Nummulina*, where there is an addition of compressed chambers on each side the central plane, expanding above and below into the globular form of *N. obtusa;* and elongating in *Alveolina*. Returning to the subgenus of *Nummulina*, which presents the "reticulated structure" externally, we have passed on to *Orbitoides*, where the characteristic spiro-central plane of the nautiloid forms of Foraminifera is beginning

to disappear, and then to *Orbitolites*, where it is entirely lost; ending with *Cyclolina*, which bears the same relation, in the simplicity of its structure, to *Orbitolites*, that *Operculina* bears to *Nummulina*.

## EXPLANATION OF PLATE II.

Fig. 1. *Operculina inæquilateralis* (No. 1). 2. Vertical section of ditto.

Fig. 3. *O.* ——? (No. 2). 4. Vertical section of ditto.

Fig. 5. *Assilina irregularis* (No. 1). 6. Vertical section of ditto.

Fig. 7. *A* ——? (No. 2). 8. Vertical section of ditto.

Fig. 9. *Nummulina* ——? (No. 1). 10. Vertical section of ditto.

Fig. 11. *N. millecaput?* (No. 2). 12. Vertical section of ditto.

Fig. 13. *N. obtusa*, Sowerby (No. 3). 14. Vertical section of ditto.

Fig. 15. *Melonites spherica*, Lamarck (No. 1). 16. *M. spheroidea*, id. (No. 2). 17. *Fascicolites elliptica*, Parkinson (No. 3). 18. Arrangement of the septal lines at the apex in the last three species.

Fig. 19. *Nummulites Garansiana?* 20. Vertical section of ditto.

Fig. 21. *Nummularia acuta*, Sowerby (No. 4): *a*, magnified view of reticulated structure on the surface. 22. Vertical section of ditto.

Fig. 23. *Lycophris dispansus*, Sowerby (No. 1): *a*, magnified view of reticulated structure on the surface. 24. Vertical section of ditto. 25. Stellate arrangement of tubercles, magnified. 26. Central part of central plane of chambers, magnified. 27. Portion of vertical section of ditto ditto. 28. Magnified view of septa, showing interseptal spaces and remains of interseptal vessel? 29. Vertical columns of cells ending in tubercles, magnified.

Fig. 30. *Orbitolites Mantelli* (No. 1): *a*, magnified view of reticulated structure of the surface. 31. Vertical section of ditto. 32, 33, 34. Vertical sections of varieties.

Fig. 35. Central plane of *Orbitolites Mantelli*, magnified. 36. Vertical section of elongated cells of ditto. 37. Vertical section where the cells are entire, and have not run into each other. 38. Vertical section of central part of central plane where the chambers are quadrangular. 39. Ditto where the internal ends of the columns interlace with each other.

Fig. 40. *Orbitolites* ——? (No. 2): *a*, magnified view of surface, showing reticulated structure; *b*, the same still more magnified; *c*, arrangement of the cells of the central plane towards the circumference. 41. Vertical section of ditto.

Fig. 42. *Cyclolina pedunculata* (No. 1). 43. Vertical section of ditto. 44. Arrangement and form of cells in vertical section of ditto. 45. Ditto on the surface.

ART. IX.—*Description of* Orbitolites Malabarica, *illustrative of the Spiral and not Concentric Arrangement of Chambers in D'Orbigny's Order Cyclostègues.* By H. J. CARTER, Esq., Assistant Surgeon, Bombay Establishment. With a Plate.

Presented 17th February 1853.

ORBITOLITES MALABARICA. (H. J. C.)

*Description.*—Free, discoidal, thin, plane or slightly concave on one side, convex on the other, smooth; presenting spiral lines on the surface extending from the centre to the circumference. Margin thick, round, rugoso-reticulate longitudinally, with one or more pores in the interstices; each pore surrounded by a raised rim or border. Size, 1-30th of an inch thick at the circumference; 7 to 8-12ths of an inch in diameter (Platè II., A, figs. 1 & 3).

*Internal Structure.*—Composed of several layers of chambers, which are formed of as many turns of an inclined plane in a vertical spire; covered externally by a thin incrustation, through which the chambers may be seen with a magnifying glass of low power. Chambers arranged in *continuous* spiral rows, extending from the centre to the circumference, and increasing in number outwards (fig. 2); alternate in adjoining rows, small in the centre, largest towards the circumference, and in the superficial layer on both sides, where they are oblong or ovoid vertically (fig. 4); each presenting two round apertures communicating with the next outer and inner chambers; the outer aperture of the external row opening on the margin (fig. 3). Septa straight, (and being perpendicular to the, and alternate in adjoining, rows of chambers,) forming *broken* spiral lines running in the opposite direction to them, so as to present the linear appearance seen on the case of an engine-turned watch (fig. 2); but with the exception, that in the former the lines increase in number outwards by the addition of more rows of chambers on the one hand, and more septa on the other, just as in *Orbitoides*. D'Orbigny's "coupe horizontale," therefore, of the latter (Cours élément. de Paléont. et Géol. vol. ii. p. 193)

is not correct, for that is identical with the lines on the back of an engine-turned watch.

*Locality.*—Abounding in an impure, bluish-green argillaceous limestone (of the Pleiocene of formations?) about 30 feet beneath the surface at Cochin on the Malabar coast, the shells of which, though deprived of their animal matter, are still white and pulverulent, or semi-crystalline.

*Observations.*—In the foregoing paper, p. 129, I have stated, that "D'Orbigny is not warranted in giving the distinguishing character of concentricity to the rows of chambers in his order *Cyclostègues*, for in his three first genera, which are all alike in this respect, we have seen that it is almost impossible to determine it; and in his last one, of which *Lycophris dispansus* is a type, it is evident that this is not the case, but that the chambers are arranged subspirally."

I had always been impressed with the idea that a spiral arrangement of the chambers was the most persisting character in the discoidal Foraminifera, and although I had succeeded in demonstrating this in *Orbitoides (loc. cit.)*, I could not do so in the other genera of D'Orbigny's *Cyclostègues*, from the smallness of the cells and their confusion in the centre of the species I possessed. In the one just described, however, there is no doubt of it. The lines of chambers are thrown off from a vertical spire, in the form of sparks from a rotatory fire-work, as I have before stated of *Orbitoides;* and, if it be the case in one species of *Orbitolites*, it is most probably the case in all, and in D'Orbigny's genus *Orbitolina*, also, which is but an extended form of the same structural foundation.

Hence if this reasoning be allowed, it must follow, that D'Orbigny's term for this order is a misnomer, for the chambers are not arranged in concentric circles as it would imply, but *spirally*, as in other discoidal Foraminifera.

I have named this species *Orbitolites Malabarica* from its locality, the specific differences between it and the other known species (with the exception of the spiral lines on the surface) not being recognizable by the unassisted eye.

*Identity of* Lamarck's *genus Orbitolites and* D'Orbigny's *Cyclolina.* There appears to me to be very little difference between Lamarck's genus *Orbitolites* and D'Orbigny's *Cyclolina*, judging from the figures of the former, in tab. 73. figs. 13-16, of Lamouroux's 'Exposition Méthodique des Polypiers,' and of the latter, in tab. xxi. figs. 22-25, of D'Orbigny's 'Foramen. Foss. du Bassin Tert. de Vienne.' Both are marginoporous, and both without pores on the surface (see Carpenter,

Quart. Geol. Journ. vi. p. 31); while the concentric circles represented in D'Orbigny's *Cyclolina cretacea* (*loc. cit.*) find their parallel also in Lamarck's *Orbitolites concava*. Carrying out this reasoning also, we find it stated by Dr. Carpenter (*loc. cit.*) respecting the Australian species of Quoy and Gaimard and *Orbitolites complanata*, that they "agree closely in every particular save the form of the superficial cells"; and as the former and *Orbitolites Malabarica* will be seen to be still more intimately allied, it also follows, that all these species should come under the genus *Orbitolites* of Lamarck. The chambers I apprehend are arranged spirally in all, though the superficial lines only appear to be so in *O. Malabarica*.

It therefore seems to me (though of course I make these remarks with much deference) that D'Orbigny's genus *Cyclolina* should be a species in Lamarck's *Orbitolites*; then the latter genus would be characterized by a thin amorphous incrustation on the surface through which the chambers are more or less visible with a magnifying glass; and in D'Orbigny's *Orbitolina*, the incrustation would be characterized by its cellular structure, as in *Orbitoides*, rendering the species or varieties more or less convex on one or both sides. In this case the species in the foregoing paper, called respectively *Orbitolites* and *Cyclolina*, should be named *Orbitolina* and *Orbitolites*.*

## EXPLANATION OF PLATE II., A.

Fig. 1. *Orbitolites Malabarica*, natural size.

Fig. 2. Portion of the centre magnified, showing the spiral arrangement of the chambers.

Fig. 3. Portion of the margin magnified, showing the marginal apertures.

Fig. 4. Portion of the internal, or opposite, side of the rows of chambers, showing similar apertures;—also the large oblong or ovoid chambers of the surface.

* This and the foregoing Articles, together with Art. V. p. 430, vol. iv. have, with slight and unimportant alteration, been reprinted from the "Annals and Magazine of Natural History," on account of their local as well as general bearing.

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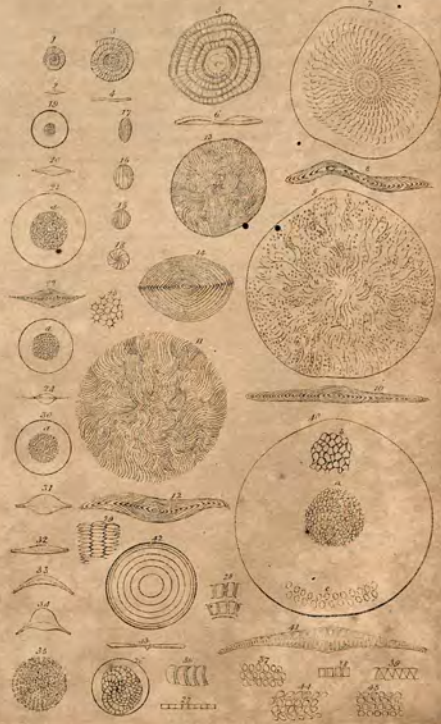

A.

ART. X.—*Note on an apparently new genus of* Gasteropod. By A. H. LEITH, Esq., M.D.

Presented 17th March 1853.

THIS minute Mollusk is met with on the shores of the island of Bombay, by the edges of salt-water pools, moving on the moist earth or rocks, and taking shelter under stones. Its chief peculiarity is having an operculum, together with two eye-tipped tentacules.

*The Animal* has a broad, short foot, a head expanded into a broad and slightly emarginated lip, used as a fore-foot, only two tentacules, which are short, nearly cylindrical, contractile, and bearing the eyes on their summits. The respiratory opening is a round perforation in the mantle, behind the right tentacule.

*Operculum* is horny, with subspiral lines, running from a nucleus near the columella.

*Shell* sub-umbilicated, with an elevated spire; aperture rounded below, and at the summit angular; peristome edged, at base effuse, lips united by callus, which encroaches on, or even covers the umbilicus.

Believing that this genus is new, it is proposed to call it OPTEDICEROS, with reference to its two eye-bearing tentacules.

Three species have been found, of which the shells may be thus described:—

1, *Optediceros corneum*.—Ovato-conical, with 6 rounded whorls, longitudinally striated; colour greenish-horny; length 0·22 inch.

2, *O. subconicum*.—Subconical, with 7 or 8 somewhat flattened, smooth whorls; colour ochrey or orange; length 0·2 inch.

3, *O. marginatum*.—Ovate, with pointed spire, 6 whorls, marked with faint striæ of increase; slightly margined below the sutures; colour ochrey; length 0·2 inch.

*Observations*.—In each of the first two species the animal is grey, and its lip is subcrescentic, while in the last the colour is scarlet, and the lip is rectangular. In *O. marginatum* reptation is slower than in

the other two species. If put into salt water, they all quickly make their escape from it, by creeping up the sides of the vessel, but if placed in fresh water, they close their opercula, and remain shut up until they die.

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ART. XI.—*On a Fossil Fish from the Table-land of the Deccan, in the Peninsula of India.* By Colonel SYKES, F.R.S., G.S. *With a Description of the Specimens.* By Sir P. DE M. G. EGERTON, F.R.S., G.S. [*Extracted from the Quarterly Journal of the Geological Society of London.*]*

GENERAL FRASER, the British Minister at the Court of the Nizam at Hyderabad, in a letter to me dated the 31st July 1850, mentioned his having transmitted some specimens of fossil fish, with impressions of leaves, in a matrix which Dr. Walker, whom General Fraser had employed in Statistical and Natural History researches in the Nizam's territories, considered as appertaining to a coal-formation. General Fraser had previously caused specimens to be sent to the Asiatic Society of Calcutta; but the reports upon them not satisfying Dr. Walker, a second series of the specimens were sent to me by General Fraser, with a request that I would ascertain their possible relations with true coal-strata.

Considering the enormous development of trap, covering some 200,000 square miles in the Deccan,—the granitic basis of the whole peninsula of India,—the area occupied by laterite,—the want of sedimentary rocks,—and the hitherto total absence of organic marine fossils in the Deccan (for a few shells brought to notice by the late Dr. Malcolmson were either fluviatile or lacustrine),—the discovery of fossil fish on the margin of the trap region was a novelty necessarily of great interest, as indicative of the former submerged state of the peninsula of India. The fossils arrived in October last, and a glance showed that the remains were imbedded in bituminous schist. The specimens were met with, General Fraser mentioned, near to the confluence of Wurda and Godavery rivers, north of Hyderabad, and south of Nag-

* Vol. vii. Part I. p. 272.

poor. But as the Wurda runs into the Wein Gunga, and the latter runs into the Godavery, General Fraser probably meant the confluence of the Godavery and the Wein Gunga. The junction of the Wurda and Wein Gunga is about 170 miles north-easterly from Hyderabad, in latitude 19° 87′ N., and longitude 79° 50′, and the junction of the Wein Gunga and Godavery is about 115 miles north-easterly from Hyderabad, in latitude 18° 49′ 30″ N., and longitude 79° 56′ 30″. I have reason to believe these localities to be from 1200 to 1400 feet above the sea-level.

The Curator of the Geological Society inspected the specimens of fossil fish, and he considered that they belong to a genus which in European latitudes is usually associated with the Oolitic formation. The Oolitic rock nearest to the locality of these fossils is in Cutch, fully 1,000 miles distant, and with a thickness of from 4,000 to 5,000 feet of trap intervening for a couple of hundred miles; nevertheless many of the European associates of oolite exist upon the Wurda and Godavery, namely, bituminous shale, wood-opal, calcareous spar, rhomboidal quartz, agates, chalcedony, hornstone, &c., and the rock itself may be overlaid by the prodigious flow of trap. It was not until the arrival in town recently of my friend Sir Philip Egerton, whose acumen and critical knowledge of fossil ichthyology render his opinion so valuable, that I was enabled to get the specimens examined with deliberate attention. But Sir Philip, with that readiness which makes him at all times anxious to render his knowledge available to others, instantly responded to my appeal, and I am permitted by him to make use in his own words of the conclusion at which he arrived after an examination of the fossils. He says:—

"The specimens with one exception are much broken, and the materials scattered confusedly over the schist; but there is sufficient evidence to show that they are all referrable to the genus *Lepidotus*, and, most probably, all to one and the same species, *that being a new one*. It is remarkable for the slender proportions of the anterior part of the trunk, and the thickness of the posterior part between the anal fin and the tail. The scales are perfectly smooth, and the free posterior margins entire, without any trace of serration. A ramus of the lower jaw is seen on one specimen, showing the teeth to be conical, with rather elongated bases. There is little doubt but that it is a true Oolitic form, and apparently of the date of the Lias. The schist in which the fish are imbedded reminds me strongly of the bituminous shales of the Lias of Seefeld in the Tyrol. It is very desirable that more perfect

specimens should be obtained, since the only one showing the form of the fish wants the head, and exhibits only the under surface of the scales."

In a second note Sir Philip adds :—" The genus *Lepidotus* extends from the Lias to the Chalk, both inclusive ; but your species bears evidence of being one of the earlier members of the race. It was probably an estuary or in-shore fish, from its frequent association with terrestrial vegetable remains, as in the Hyderabad specimens."

Sir Philip Egerton has so ably and completely exhausted the subject as far as the specimens permitted, that it only remains to me to name the new fish ; and as it was very much my practice in my Natural History investigations to associate new species with the localities or provinces where they were met with, I would propose to call the specimen *Lepidotus Deccanensis*.

I have written to India for more specimens, but as the discoverer, Dr. Walker, has lately unhappily lost his life by a fall from his horse, I am not very sanguine about their receipt.

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## ART. XII.—*Postscript to the "Geology of the Nagpur State." By the* Rev. S. HISLOP.

Received 2nd August 1853.

IT has been assumed in my paper on the Geology of the Nagpur State, that the Eocene deposit is co-extensive with the former of these formations. This, I think, will be admitted, when it is considered, that there are many out-crops in Western India described as of "red bole" by Newbold, and "red ochreous rock," "pulverulent limestone," and "mesotype" by Sykes, which, though not fossiliferous, really present examples of our freshwater strata. The trap, then, overlying, as it does, a lacustrine formation, must have been poured forth in an

immense lake, or chain of lakes, it may be, similar to those of the North American Continent; and, therefore, the idea of a submarine effusion is wholly groundless. But how, then, it may be asked, are we to account for the flatness of the trap hills? Must they not have been consolidated under great pressure? The vicinity of Nagpur supplies the answer. Nowhere are the outlines of the hill tops more horizontal than in Central India; and yet, judging from the abundance of pulmoniferous mollusca which are there found, the freshwater in which they lived, and in which the igneous rock was afterwards spread out, must have been so shallow as to allow the molten mass to appear above the surface of the lake in the atmosphere.

Again, it has been taken for granted, that the plants figured on the last plate of McClelland's Survey for 1848-49 are, as there stated, fucoids. Though I have thought it right, from not having seen the specimens themselves, to reason on this hypothesis, yet I am of opinion, from the figures which he has given, that his so called *Fucoides venosus* is nothing but a *Glossopteris;* and that, consequently, there is no proof whatever of the Bengal coal measures having been deposited in the sea, but every likelihood of their having been formed in fresh water. The same may be said of the shale at Kotá, on the banks of the Pránhitá, where the *Lepidotus Deccanensis* was found. This genus of fishes is, indeed, as frequently met with in marine as in freshwater formations; but from the impression of a bivalve, left on a fragment of the shell kindly sent me with scales of the *Lepidotus* by Dr. T. L. Bell, who has already thrown much light on the geology of the Nizam's country, I am inclined to believe that the shells will show the strata to be lacustrine. Combining this conclusion, then, with other premises previously established, the deduction from the whole seems to be, that the ocean has not swept over the Deccan since the commencement of the Oolitic series in India.

*Recapitulation of the leading propositions illustrated in the preceding Paper and Postscript.*——1*st.*—The Regur appears to be the product of decayed vegetation, accumulated in marshy situations, or under a humid atmosphere. 2*nd.*—The Laterite is probably caused by ferruginous matter diffused over the *debris* of any kind of rock, whether igneous or sedimentary. 3*rd.*—The Overlying Trap of Central and Western India cannot have been poured out in the bed of the ocean, but must have been erupted in a lake or chain of lakes, and consolidated in general under no greater than an aerial pressure. 4*th.*—The Freshwater Formation under this Trap,

in so many localities of the region just named, is obviously of the Eocene period. *5th.*—The Sandstone of Central India, which appears to be identical with the Diamond Sandstone of Southern India, belongs, with its associated Shale, and the India Coal Measures, to the Lower Oolitic Formation. *6th.*—The first mentioned of these rocks is of freshwater origin, and so, there is reason to believe, are also the others. *7th.*—The Deccan exhibits no evidence of having been submerged by the ocean since a period anterior to the Oolite.

*Errata.*

| | | | |
|---|---|---|---|
| Page 59, | lines 18, 19, | *for* "first, fruit, an" | *read* "first-fruit and" |
| ,, 62, | line 17, | *for* "*Bithenia*," | *read* "*Bithinia*," |
| ,, ,, | ,, 33, | *for* "Khanari" | *read* "Khánání" |
| ,, 63, | ,, 24, | *for* "Weirázad," | *read* "Weiragad," |
| ,, 64, | ,, 5, | *for* "Shek Jarid," | *read* "Shek Farid," |
| ,, ,, | ,, 13, | *for* "these" | *read* "the" |
| ,, 66, | ,, 8, | *for* "Chonki," | *read* "Chouki," |
| ,, 69, | ,, 30, | *for* "Brown," | *read* "Bronn," |
| ,, 71, | ,, 4, | *for* "Koohádi" | *read* "Korhádi" |
| ,, ,, | ,, 20, | *delete* "endate at the base, and" | |
| ,, ,, | ,, 38, | ,, ":" | *after* "rows" |

JOURNAL

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## ART. I.—*Sahyádri Inscriptions.* By the Rev. J. STEVENSON, D.D., President.

Presented 20th October 1853.

IN presenting transcripts and translations of the more perfect inscriptions found at Kárle*n* and Junir, on the Ghauts, and Kude*n* in the Concan, I shall reserve any general remarks, additional to those I have already made under the heads of the Káṇheri and Násik Inscriptions, to the conclusion of this paper. I may observe, however, that several of these inscriptions have been before translated by Mr. Prinsep from copies furnished him by Colonel Sykes; and that in reviewing these, along with the rest, if I differ somewhat occasionally from my master in Indian Palæography, it must be remembered that Prinsep had but a small portion of the inscriptions before him, and, therefore, had not the advantage of comparing them one with another; nor had he an opportunity of correcting his first impressions, as I have been enabled to do, by subsequent researches.

## 1st.—TRANSCRIPTS IN DEVANAGARI, AND TRANSLATIONS OF KARLEN INSCRIPTIONS.

### No. I.

This inscription is engraved on a pillar outside the Great Temple-Cave.

सिद्ध महारविस भोतिपत्रस अगिमित नाकस सिह थभो दानं सिद्ध

*Translation.*

Peace. The gift a of lion-crowned pillar, by the Chief Agni-Mitra, son of the Emperor Bhúti. Peace.

*Notes.*

I have already made remarks on this important inscription in p. 3 of my observations on the Káṇheri Caves, and shown that this Mahárája Bhúti was the last of the Sunga dynasty. राव is a common Maráthi corruption of राजा as well as राई. By some oversight, or defect in the ink of the transcript, Mr. Prinsep read the first letter स, instead of म. This is corrected in Dr. Bird's work on the caves. I follow Prinsep, however, in making the sixth syllable भो instead of गो. In Colonel Sykes' transcript used by him, the former is undoubtedly the reading, though in Mr. Brett's fac-simile it is doubtful which of the two it should be made. In a very good copy of this inscription, published in the Asiatic Researches, vol. v. p. 141, and furnished by Sir Charles Ware Mallet, we have very plainly भो, which is also the reading of Captain Jacob. (Jl. Bengal As. Soc. vols. vi. p. 468, and iii. p. 498.) This, too, on examination, was my own impression of the character in question. The only syllable with which वि might be confounded is ठि; but by comparing Nos. I., II., and III., and No. I. of Bhájá, a marked difference will be found in the length of the ascending line before it becomes circular: but in this reading all are agreed. नाक is the vulgar Maráthi of नायक. If instead of ना we should read ण, the meaning will still be the same; the palatine being substituted for the dental, as usual, and the syllable shortened.

### No. II.

This inscription is engraved on a recess on the right side of the porch.

ओं विजयं तितासेविणा भूतपालेन सेलघर परिनिठपितं जबुदीपम्हि दान मग्गे.

*Translation.*

To the Triad. By the victorious, fearless, world-protecting, Bhúti, this mountain abode was established in Jambudvípa, in honour of the hero who subdued the passions.

*Notes.*

I suppose the character at the commencement to be *Om*, though I am not entirely satisfied that it is so. The ह्मी after Jambudvípa is the sign of the locative case in Páli. The next word is the Prácrit for दानम्, and the last word I conceive to be for मनवे, the dative of मनु, taken in the sense of a patriarch or distinguished man, and applied to Buddha. The mention of this cave, as if it were the only one in Jambudvípa dedicated to Buddha, seems to intimate that it was the first excavation of the kind in India; a supposition which, from the simplicity and elegance of its parts, is otherwise probable. निवास is चिवास. From the position, I suppose that this inscription was added by some local Buddhist after the excavation of the cave.

No. III.

[1] ओं राज्ञो वाशिवि पुतस सिमिसर [पुदुमावस] समचरे सतमे ७ पखे पचमे ५.

[2] दिवसे पथमे १ एताय पूवाय देखट कियान महारठस कोशिक पुतस मतदेवस पुतेन.

[3] [चस] सारथिना वाशिवि पुतेन सोमदेवेन गामो दतो व लेण सघस व पुरकलननस कर करोस देय [ध] मो यो.

*Translation.*

To the Triad. In the seventh year (7) of the fifth demi-lunation (5), the first day (1) of the fortunate Emperor [Padma], son of King Vásivi, a village was given to those distinguished for their former meritorious acts, by Matadeva, son of Kosika, distinguished among the commanders of war chariots, and by Somadeva, the son of the famous charioteer Vásivi. A cave also was given as a religious assignation to the priesthood, and to those performers of religious acts who are full of knowledge and wisdom.

*Notes.*

This is one of those interesting dated inscriptions, on which, under the head of Násik inscriptions, I have already remarked, and on which I may still have some more observations to make at the end of these translations. In the second line we have महारठ, and in the third line महारथि. In the transcript by the Rev. Mr. Mitchell, contained

in Dr. Bird's work, these are nearly reversed, and we have महारथि for the first, and महारठि for the second. I am warranted, then, I think, in considering them the same. On the descriptive terms applied to the Buddhist priesthood both above and below I need make no remarks, though, except संघ, they are all peculiar, as the sense in which I understand them will readily appear from the translation, except, perhaps, कलनन, which I suppose to stand for कलाज्ञान.

## No. V.

### *Notes.*

Passing over No. IV. at present, I remark that No. V. has reference to the abovementioned village, bestowed as a free gift upon the monks of the temple. The name Karanjaka at the commencement is plainly legible (गामस करजक); and at the beginning of the second line in Dr. Bird's work the word भिखस is also easily legible, thus pointing out for whom the village was intended. There are, however, so many blanks and broken letters in the inscription, that I have not attempted to translate it. In what remains, the names of the donors do not appear. Of this inscription a fac-simile, with the image of Buddha, after a drawing by Colonel Sykes, above which it is, will be found in the Jl. As. Soc. Bengal, vol. vi. pl. viii. It follows immediately No. VII. given below.

## No. VI.

### *Notes.*

The same remarks apply to this inscription. At the end of the first line is the name of the village Karanjaka, and the rest appears to be either a description of the village, or of those for whom it was intended.

## No. VII.

[1] ..... समा मोख अमच परागत खमे सवथ लखु सवा पेरक सवाथवान

[2] पवजिताने भिखुना निकाय समुह सघाय नयपतीघहथ मामा लोहारे उतर मग गाम करजको

[3] भिखु हरे दडुम एतसच गाम करजको भिखु हले देय पपोहि एतस खस.

### *Translation.*

The village Karanjaka, which lies to the north of the road of the householder Mámá the blacksmith, has been given to the collective body of the priesthood of initiated monks, who are..... free from passion, and have overcome disease; are characterised by universal compassion, command all things, and possess every object of desire.

We grant the village Karanjaka to be taken possession of by the

monks, and as a gift to be cultivated by the monks, along with the water tank in the same district.

*Notes.*

This inscription, it will be seen, has still respect to the same subject. It is in a very conspicuous position, on the left of the doorway of the temple. It is mutilated at the top, but most of it remains. The last line, which is a kind of repetition of the former part, is interrupted by small pilasters, which makes it appear as if there were blanks it, which, however, is not the case. A village of this name, or rather in the shortened form of Karanja, still exists among the Ghauts, a few miles from Kárle*n*, and is now held in *inam* by the Kárve*n* family, descendants of the Guru of the late Peshwa,—rather a curious coincidence.

Though I have found considerable difficulty in dividing the letters into words, and translating this inscription, I need hardly point out to the Sanscrit scholar the proper substitutes for the Prácrit words. I may notice, however, that पपोहि is a union of the Sanscrit प्रपा and the Maráthi पोहि, and that ख in the last word is considered to be an abridgement of खेत, the Prácrit of क्षेत्र. Also, it is to be kept in mind, that प्रवर्जित means initiated. (See Káṇheri Inscriptions, p. 31.) I had almost forgotten to notice, that I consider the formation of the image on the wall outside the temple, over which this inscription is placed, together with the gift of the village referred to, to be long posterior to the excavation of the temple itself, for which the reason will appear in my former paper.

Nos. VIII. and IX.

भद्दसमस भिखुस देयधम मिथुन.

*Translation.*

The religious assignation of a pair (of images) by Bhadrasama the monk.

*Note.*

These two inscriptions are the same, only that one or two of the letters in the first are a little imperfect.

No. X.

धनुकाकटा (सु) भाविकस सद्दातस दान घर मघ.

*Translation.*

The gift of a pleasant abode by Dhenukákaṭa to the devoted men of patient and subdued minds.

*Notes.*

This inscription, I believe, is connected with one of the small caves. The last word is puzzling. मघ means pleasure, but perhaps it may here be a corruption of मङ्ख, a kind of mendicant, and the meaning be a house suited to such persons. The type of the letters in this inscription is very ancient and beautiful, as it is in the others also of this class.

No. XI.

धेनुकाकटा उसभदत पुतस मितदेवणकस थभ दानं.

*Translation.*

The gift of a pillar by the Chief Mitradeva, son of Dhenukákaṭa, (surnamed) Rishabhadatta.

*Note.*

I suppose Dhenukákaṭa to be a Greek, and that he had also a Hindu name, as in the text, probably assumed when he embraced Buddhism, or on adoption into some Hindu family, when names also are changed. णक or नाक we have met with already, in No. I.

No. XII.

वेागहतस महादेव णकस मातताथि लय दान.

*Translation.*

The gift of an abode, for the benefit of his parents, by the formidable Chief Mahadeva.

*Note.*

The first word I understand to be equivalent to औायहृत्.

No. XIII.

नि सिध. Peace. To the Perfect One.

*Note.*

Buddha is here no doubt meant. There should probably be a point over ध.

No. XIV.

In this number, we have the last of the inscriptions that mention Dhenukákaṭa.

धनुका कध यवनस सिह धयानं थभ दानं.

*Translation.*

A gift of lion-supporting pillar, by the Greek Xenocrates (Dhenukákaṭa).

*Notes.*

We have thus no less than three inscriptions at Kárlen, and one at Káṇheri, in which this personage is mentioned. His name is, indeed, spelled differently every time, but this is nothing more than what is usual in India. I took up lately a Maráthi newspaper, and found a particular word, that occurred four times, spelled exactly four different ways on the same page. The orthography Dhenukákaṭa I suppose to be the most correct, as it is capable of being divided into two Indian words, the first of them the name of a Rákshasa, mentioned in the Puráns, and the second meaning an agent, and, perhaps, an artist. It is the custom everywhere, in adopting foreign words, to make them, if possible, significant in our own language; and the nearest Greek name seems to me to be Xenocrates. If the accent be put on the anti-penultimate syllable, as is usually done, that will seem to double the letter *c*, the Greek κ. By a similar process, the English word Collector is in Bombay transformed into Cálakaṭṭar. Besides, in Prácrit the *r* is usually omitted, and the next *t* made a palatine letter. By this process, and the substitution of *Dh* for *X*, which does not exist in Prácrit, and the change of the termination to an Indian one, the transformation is completed. I think this Greek name more probably the one meant than Theonikos, suggested by Dr. Wilson. Of this Xenocrates, then, it is said he was a Yavan, which all agree must, in ancient Indian documents, mean a Greek. It is the Hebrew Javan, as we write it, but which should be pronounced as the Jews still do, agreeing with the Indians, Yavan, which has evidently the same radical letters as the Greek Ιων. He had an Indian name, Rishabhadatta, and a son, who is mentioned in No. XI. He was an artist, as is recorded in the Káṇheri inscription No. X., where he is called कलपकमनक. He was a convert to Buddhism, as in the same inscription he is called an Upásaka. The presence of such a Greek at these excavations could only have one object, that of superintending and directing the workmen. Besides, he must have been a man of influence to obtain permission to inscribe his own name on these rocks, and of property to enable him to execute the works he is said to have done at his own expense.

No. XV.

On the fourth pillar from the door, on the left of the temple.

सपारकाभयंतान षमुतरीया नंभण
कस सानि मितस
समरीवथभ दानं.

*Translation.*

The gift of an image-sustaining pillar, by the exalted Chief S'ánti Mitra, who is clothed with religion, to those who save us from the fear of corporeal attachments.

*Notes.*

The two last lines of this inscription are shortened by being confined to one face of the pillar, which the first is not. The first word I suppose to be derived from संपक; after धर्म I read उत्तरीय, "covering, clothing," taken in a figurative sense. The Sanscrit equivalents for the rest are apparent.

I formerly read the name of the Chief here mentioned Jagamitra, but, on looking at it more carefully, I believe it to be as I now give it.

## Nos. XVI. and XVII.

These two Nos. are too much broken to permit me to make anything of them. The second begins with *Nukákata ;* probably *Dhe* is to be prefixed, and then it will belong to the same series as X., XI., and XIV.

## No. XVIII.

This inscription is engraved on an excavation adjoining to the Temple-Cave, intended, as appears from its tenor, for a lodging-house and refectory for monks and pilgrims. It is one of those on the date of which we before made remarks.

सिध. राज्ञवासवी पुतस सरपुदुमावस सवक्र चतुवीसे २४ हेमतन पखे ततीय ३ दिवेसि बति ३२ उपासकस हरफरनस सतुपरण पुत्रस सेवसकस अबु लोमय वथवस्य रम देयधम मटप उधगत विप्र सघियन प(भि?) खुगहस घि चतुसदिश मातपितन पुजा सवसतान हित आघद चतुय २४ वीसेसि वक्रे निखितो सह तच मे प्रत बुधरखितेन तत रचत्य उपसकय बुधरखिय मास दाय धम पाठो अपि.

*Translation.*

To the Perfect One. In the twenty-fourth (24) year of the Fortunate Padma, son of king Vásava, in the third (3) demi-lunation and thirty-second (32) day of winter, this delightful religious assignation was made by the long-haired mendicant Sevásakta, son of the wavy-garland-wearing devotee Satva Sphuran. Come then to this residence, constructed from reverence to my parents, ye company of learned men of elevated mind—to this house for mendicant priests, from the four quarters (of the world). This inscription also was engraved with a chisel in the twenty-fourth (24) year, on my account, by Buddharakshita, in the

month when the threads which insure the protection of Buddha are bound on the arms of devotees.

*Notes.*

It is not worth while to point out to the Sanscrit scholar the equivalents in this inscription, as they will all readily occur from comparing the transcript with the translation; although in some instances there is room for a difference of opinion, as in मटप, which I interpret मंचपा: The last line is difficult, and I may have missed the sense. I conceive it to mean that the inscription was executed on a lucky day—that on which, according to the custom of all sects of Hindus, charms are bound round their own arms, and the necks of their cattle. This day in our Presidency is different in different districts, but always the same in any given place. Perhaps पाढो, after all, may be our old friend पोढि; and it may be its excavation that is recorded.

No. IV.

*Notes.*

This inscription belongs to the Satrap series, which is so prominent in the Násik caves. It is in Prácrit, as all at Kárlen are, and the form of the letters is evidently of the Gujaráthi type. It is too much broken, however, to admit of a continuous translation.

The first line mentions that the son-in-law of Nahapána, the Satrap of king Kshaharáta, bestowed —— thousand húns at the river Bárṇásoya; and lower down, in the fourth line, a donation to the mendicant priesthood is mentioned.

BHAJA INSCRIPTIONS.

Bhaja is a small village three miles S.E. from Kárlen, the Buddhist remains of which are described in the Jl. Bom. As. Soc. vol. i. p. 483, by Mr. Westergaard.

No. I.—Over a small tank.

ओं महारठिस कोसिकी पुतस
विण्हुदत्तस देयधम पोढी

*Translation.*

The religious assignation of a cistern by Vindhyadatta, son of the famed charioteer Kosiki.

*Note.*

Though the orthography of the last syllable varies, the Kosiki here mentioned is probably the Kosika of No. III. of Kárle*n*. The cast of the letters is exactly the same, and also the form of the initial figure.

No. II.

This inscription is engraved on a small dágoba.

नदस वदनयस
भगवतस गाभेदानं

*Translation.*

The gift of a sanctuary to the joyful, venerable lord.

*Note.*

I do not find here the name of the donor, as usual. The inscription, then, was probably engraved by a priest, at some period future to the construction of the dágoba.

N. B.—The two inscriptions at Beḍse*n* or Birsa have not been taken by Mr. Brett. Copies of them by Mr. Westergaard will be found lithographed in Dr. Bird's work, and in vol. i. of our Journal, in the plate fronting p. 438. The first, of one line, seems to celebrate the construction of the cave over which it is carved by an inhabitant of Násik. The second, of three lines, mentions the charitable gift of a water cistern, by a person there mentioned, whose name I cannot certainly make out. I fear the lithographer has not done entire justice to Mr. Westergaard's copy of these inscriptions.

## JUNIR INSCRIPTIONS.

As Mr. Brett's plan of the locality of these caves sufficiently explains where each inscription is to be found, I need not refer to this point further than to direct the inspector to it. Very correct facsimiles of many of these inscriptions, taken by Colonel Sykes, will be found in the Jl. Royal As. Soc. vol. iv., with an account of the caves. Dr. Bird's work can also be referred to, and the Jl. As. Soc. Bengal, vol. vi. p. 1045.

No. I.

ओं. धन्यीक सेनीय सतगभं पोढीच दाय धम ॥

*Translation.*

To the Triad. A chamber for a refectory, and a water cistern, by the military officer Dhanyaka. A religious assignation. Peace.

*Notes.*

The two words सत and गभ may be translated as if uncompounded, and then the sense will be a sanctuary and refectory; but the point over the भ seems to intimate this is not the case. (See Káṇheri Inscriptions, pp. 8, 15, 22.) We have here दाय instead of देय, if there is no mistake in the transcript.

No. II.

सि कलीअन्यस हेरणिक पुतस सुलासदातस ठकपुरिसस चेतिय घरोनियुतो देयधम सि

*Translation.*

Peace. The religious assignation of a chaitya temple, constructed at the command of the lord of Thakapura Sulásyadatta, son of Heraṇika (a goldsmith), inhabitant of Kalyaṇa.

*Notes.*

The Sanscrit टंक, like the Maráthi टोक, means the peak of a mountain; and since Junir is situated on the high road from Devagiri (Dowlatabád) to Kaliaṇ, on one of the peaks of the Ghauts, and the present name means the old town, I suppose it to be the Thakapura here mentioned. नियुतो, for नियुक्त, here should, I think, be rendered "commanded or ordered," and construed as I have done.

No. III.

ओं. कपिला उपासकस नतु नैतापस उपासकस सि
ओं. पुतस आनदस देय धंमं चेतियघरो नियुतो सि

*Translation.*

The religious assignation of a chaitya temple by order of A'nanda, grandson of the devotee Kapila, and son of the ascetic Naya, also a devotee.

*Note.*

Here we have ओं at the beginning, and सि at the end of each line.

No. IV.

सि कलीअन्यकस कुटोर पुतस सुवंणकारस सघकस पेढी देय धंम सि

*Translation.*

Peace. The religious assignation of a cistern to the priesthood by Suvarṇakára (a goldsmith), son of Kuṭira, a citizen of Kaliaṇ.

No. V.

दसि मल्ल सामिणो ऽ भय
न उपासिकय नादक तारिकस
ले [ण] किनिकय देय धम पोढि

*Translation.*

The religious assignation of an excavated cave (Leṇa) and cistern to the excellent ascetic, fearless sages, by the devotee Nándaka Tárika.

*Notes.*

The initial auspicious mark in this inscription is peculiar. I suppose it may be a form of ॐ (Svastika). Perhaps म, the third letter, should be वि, and then विल्ल, being joined to the next word, will give "the cave ascetic." If म remains, the next letter, ल्ल, should be doubled, to make मल्ल. We have here the word सामिण (*Sanscrit* श्रमण) for a Buddhist ascetic. From the Sanscrit comes the Greek Σερμανης, and from the Prácrit Σεμνος, and Σαμαναιος. A few of the letters of the inscription are apparently badly or imperfectly formed. The letter I have made सि in the second line more resembles सट, and दे in the last line is like देा. Perhaps here also we should, instead of अभयन, read भयन in the sense of भदंत as noticed below; and for fearless, translate venerable.

No. VI.

मोम उपासकस पुतस ॐ
सिवकुतिस देय धम लेणं
कपिचिता संघस निजुतक

*Translation.*

The religious assignation of a cave by Sivakriti, son of the devotee Soma, destined for the tender-hearted priesthood.

*Notes.*

Regarding the initiatory symbol, I have no information to give. It is not improbably a form of *Om*, the three superior branches designating trinity, and the inferior circle unity. Among the Jain lucky figures, the कुंभ, or flower-pot, taking merely the general outline, will agree pretty well with the initial symbol here, and, possibly, this may be what is intended. There is also the *Gokhúr*, or cow's hoof, which resembles the upper part of it. Perhaps the word निजुत might imply the performance of some ceremony, similar to the निसर्ग of the Brahmáns, by which the proprietor renounces all property in the temple, &c. dedicated to religious purposes.

## No. VII.

वीरसेणकस गहपति पमुघस
धमनिगमस देय धम चेतिय धरो
नियुतो सवि लोक हित आणोयं

*Translation.*

A religious assignation of a chaitya temple, dedicated to the religious men skilled in sacred learning, by Virásenaka, first in rank among the citizens. Bring all people here.

*Notes.*

The same remarks as were made on the initiatory symbol of the last inscription will apply to this, only that this more resembles the Jain मीन, or fishes, which form one of the eight lucky figures. The word प्रमुघ in the end of the first line I conceive to be a corruption of प्रमुख, similar to प्रगट, which the Marathás use for the Sanscrit प्रकट. The mark for उ seems too plainly expressed to be a mistake, and therefore Mr. Prinsep's suggestion from the reading मघ is inapplicable. After गह, also, our reading is plainly प, and not ल. Probably the person in question, if not head of the police, was the chief of the mercantile caste, and had a certain authority and responsibility on this account. The concluding formula in similar inscriptions at Kánheri and Násik has been "come," &c., and not "bring"; but I fear आणोय cannot be so rendered.

## No. VIII.

सुपखरियाणस वगिरिनासस पुतस पतीवधकस गिरिभुतिस भिखुयाकस लेण पोढीच [दे] यधंमं एतसच लेणस पोढियाच नकरच गिरिनि उपासयस धमुतरियान अखय निविक.
एतो लेणस चिवरिक काहपकस सिपरिय चीव [र]

*Translation.*

The religious assignation of a cave and cistern by Suprakhariyána, son of Vagirinása, for the self-denying, strong-as-a-mountain company of monks. There is also connected with this cave and these cisterns the capital stock left by Nakara Giriní, the devotee, for those who are entirely devoted to religion. There is also in this cave an endowment for giving money to mendicants, and supplying them with skins and clothing.

*Notes.*

There are considerable difficulties in this inscription, especially in

the last line. The meaning of the six last letters, I think, however, must be near what I have given. चीवर means such clothes as mendicants wear, and अजिन "skin or leather." The skin probably was for the purpose of a rug to lie down on, for which purpose dressed deer and tiger skin is still used by ascetics, instead of a mattress.

## No. IX.

This inscription is in the same cave as the last, and probably has relation to the same thing, as some of the words agree; but as all the lines are considerably broken at the beginning, I find that I cannot give a satisfactory translation of it.

## No. X.

गणा चरियान थेरान भ
यंत सुलासानंते विजा
न अंतेवासिनं थेरानं भ
यंत चेतिय सानंते वी
न नदनन नवकं

*Translation.*

To the spiritual guides of the company (of priests), the established teachers (Theros), the venerable Sulasa, and Ananta Vijaya; to their disciples, the established teachers, the venerable Chetiyasa, and Anantevi.....

*Notes.*

This imperfect inscription contains the names of a number of the principal persons once connected with the monastery over which they are inscribed, similar to what we found in No. IV. of the Kánheri inscriptions (p. 25). That, also, when compared with this, has led me to the right rendering of भयत, which I formerly supposed to be भयत्र, "delivers from fear," but here it is used for भदंत, and has the anusvára over the य as a substitute for न्. The word गहपति appears in the 7th line, so that the inscription probably recorded some donation from one of the laity to the priesthood.

## No. XI.

सनिति गहपति पुतस गहपतिस सिवदासस वितीयो नय च सह पकवा

*Notes.*

This imperfect inscription records a donation from the householder Sivadása, son of the householder Saviti. It is worthy of observation that

a Sivadas is here found among the worshippers of Buddha. बितीयो नय may mean the second moral duty (दान), charity; and the last word may have reference to the distribution of cooked provisions, but in the want of the context it would be hazardous to affirm anything certainly on the nature of the donation.

## No. XII.

सि भारुकछकानं ईकुटियानं मातूनं
बुधरिक्षतस बुधरखितसच बोगभ देय धंमं ॰

*Translation.*

Peace. The charitable assignation of the court of the temple by Buddha Mitra and Buddharakshita, for the homeless fathers from Broach.

*Notes.*

I suppose Bharukachha is rather Broach (बडोच) than Bhúj, in the province of Cutch, as I conjectured before, p. 50 of Násik inscriptions. The वि initial is very frequently in Maráthi changed to ई, and I suppose that to be the case here. बोगभ in the sense here given will be found in the Káṇheri inscriptions (p. 23). Attracted by the holiness of the place, these foreign devotees, having come to Junir, had the verandah of the temple assigned them for a residence, and this inscription engraved as the title deed.

## Nos. XIII., XIV., and XV.

These inscriptions, found on the pillars in the portico of the temple, were probably engraved at a later period than its excavation by visitors. In the 3rd line of No. XIII. we have plainly the name उमज; regarding others, conjectures might be formed, did the inscription promise to offer anything worth the while of a closer examination. It is possible, also, that it may be of the same nature as No. X., and be the names of the heads of the society.

## No. XVI.

गामेविनिचा श्री सुक रजभूति उदेसेण निवतणानि २० वीस॥ गाम प्रप सुश्रो वतणाने.

*Translation.*

In the village of Vitihá, through the influence of S'ris'uka, the king's minister, twenty acres of land were (bestowed): the village and watering place to be a fortunate, firm possession.

*Notes.*

I am sorry that the state of this important inscription does not permit me to give a more satisfactory transcript and translation. Several of the characters are either incorrectly given, or so peculiar, that they must be guessed at: two letters of the name of the village mentioned fall under this head, and the first letter of the name of the donor. The two last letters of the name, however, are very plain and well-formed, and exactly agree with those of the first monarch of the A'ndhra dynasty whose name in the Matsya Purán is written S'is'uka. Our first letter cannot be शि, but it may be शो, and probably this is a more correct reading than the Puránic one. I suppose he was at the time of the grant only prime minister, hence he is here called राजभृत्य, and in No. XVIII. आन्ध्रकभृत्य, which is almost his Puránic epithet. If he had been sovereign, we should have expected also in the second line आदेशाने, and not उद्देशाने. The *nivartana* is a piece of land of four thousand square cubits; so that, though I have rendered it by the word acre, it is not equal to an English acre. It will correspond, nearly, to the bighá in use at present in most parts of this Presidency, and is thus about three-fourths of an acre. I have merely guessed at the last line: perhaps the curious character that stands fourth is nothing more than नि; and the sense will then be—" In the village and watering-place are —— acres." In this case the inscription is incomplete. On the whole, it seems evident from it, that land, to the extent mentioned, was given to the monastery, through the first monarch of the A'ndhra dynasty, while yet prime minister.

## No. XVII.

From the shortness and broken state of many of the letters of this inscription, I find it difficult to give an intelligible translation of it; and therefore pass it over at present.

## No. XVIII.

आधाका भति निवतणाणि .. वाहतेव खेतकस

*Translation.*

A field for out-door recreation by the A'ndhrabhritya, of —— acres.

*Notes.*

Mention is made only in a cypher of the number of bighás of land in this donation; and as the cypher occurs nowhere else, that I can

find, I forbear speculating on its value. This inscription is distinct, and Dr. Bird's fac-simile differs from ours but in one letter, so that the interpretation may be received with a good deal of confidence.

## No. XIX.

महवाकु गामेजाधभति उदेसेण निवितणानि पञ्चविस सधा वण्ट अपराजितो सखतानि सेलस.

*Translation.*

Through the influence of the A'ndhrabhritya, born in the town of Maháváku, twenty-five acres (were given) as a perpetual portion on this incomparable mountain abode.

*Notes.*

I do not know if there be any town in Telingána that bears a name in any way resembling the one given in our text; but the letters seem all plain and unambiguous. Is this a contraction of Varankal, the name of the ancient capital? सधा is for सनधा. The word संस्थान is a favourite among the Maráthas for a place where holy men reside, or for a village given for the support of religion; सखतान I suppose here to be a corruption of it.

## No. XX.

This, again, is too much broken, and contains too many anomalous letters for me to attempt to translate.

## No. XXI.

कोणाचाके सेणिय
यव सको आद्रिमिञ्जि
शिको ॥ वाटालिकायक
रजमूल निवतणानि वीस ॥
कूट पुतिक मड [ध] म्मलेन
वितस दे [य] धस ॥

*Translation.*

Twenty acres, according to the royal standard, from the military officer Koṇácháka, producing barley and mountain fennel, and adorned with garden flowers. The religious assignation to those of discriminating knowledge of an ornamented cave, for religious purposes, by the son of Kuṭa.

*Notes.*

The meaning of the name of this military officer, in Maráthi, is

"One who has the keenness of Mars, (or) is a worshipper of Mars." The names of the vegetables here, except the first, are doubtful, as several of the letters are anomalous.

## No. XXII.

*Notes.*

This inscription contains the record of a religious assignation, by Dhanyapálaka, of a Sanghagriha, or monastery, to the priesthood; but so many of the letters are anomalous, that I cannot venture to translate it, though I think the first line contains the name of a village, and perhaps the word for acres. If so, the letters are a good deal corrupted.

## No. XXIII.

*Notes.*

This inscription contains a record of no less than five different donations, for so often does the term देयधर्म occur: once in the first line, twice in the second, once in the third, and once in the fourth. In the first line the donation is (तेसे सवण्ण) three hundred gold mohurs; in the second (निवतणानि पाचस) fifty acres; and in the fourth a certain number of (आधक मूल निवतणानि) "acres, according to the A'ndhra standard." The word गामे, for "in the village," is also twice plainly legible; but amid the number of broken and uncertain letters, to attempt to make out the names of men and villages, as they originally stood, would be labour in vain.

## No. XXIV.

गामके सिरि वलवाय खेत वोरठान घरस प्रवसे निवतणानि अठा ८ काक ४ [अजि] तिय सेनिय .... देयधस.

*Translation.*

The religious assignation of eight (8) acres and four (4) poles, by the military officer Ajitya, being a field in the village of S'rí Valavá, for the lodgers in the abode of Vírasthána.

*Notes.*

This is the last of a series inscribed on the walls of the last but one of the three southern groups of caves. They are all more or less imperfect, and, therefore, it is with difficulty that any of them can be translated. Still they are important, as showing the numerous grants of land made by individuals to the support of the monks dwelling in those

caves, and on account of the mention several times made of the A'ndhra-bhrityas, the first sovereign of which dynasty, I conceive, is here specifically named, in reference to a time when he had not yet ascended the throne; leading us back to about the year 20 B. C.

I may notice, that there is a village half way between Kárle*n* and Waḍgam at present, called Valvaṇ. Whether Víra here means Buddha, or some previous excavator of a cave, is open to conjecture.

No. XXV.

सिवसमपुतस सिवभुतिणा देयधम पोढि

*Translation.*

The religious assignation of a cistern, by S'ivabhúti, the son of S'ivas'ama.

*Note.*

The names in this inscription point to a votary of S'iva: whether he was a convert to Buddhism, or merely caused the tank referred to to be excavated as a matter of charity, is not said.

No. XXVI.

ह खतपस राम नहपानस.....
सवक्स गोतस अघमस .....
मच चिमटप च प्रज्ञ थयवस मणकेतो

*Translation.*

In the —— year of the Imperial Nahapána this subterranean abode (was excavated) for those acquainted with the sacred triad invocation, and established in wisdom, by ——, of the family of Aghama. (*Quære* Angirasa?)

*Notes.*

We have here mention made of the Parthian Satrap who figures so prominently in the middle group of the caves at Násik. Some of the letters in the last line are anomalous; and, therefore, much stress must not be laid on the translation of that portion of the inscription.

## KUDEN, OR KORAH INSCRIPTIONS.

The locality of this village, on the Rájapuri creek, to the south of Bombay, the extent of the Buddhist remains existing there, and the account of their discovery by Vishnu Shástri, will be found in vol. iii. of our Society's Journal, in Dr. Wilson's very complete and interesting

memoir on the subject of cave-temples and other remains in Western India.

No. I.

अयितिलु उपासकस धंमुन सतयाय ( भयि
लया लमनोय चेतिय घरे। देयधंमं

*Translation.*

The religious assignation of a chaitya temple for a place of worship, and a delightful secure asylum to the religious, by the devotee Ayitilu.

*Notes.*

The last syllable of the name of this lay devotee is a common nominal termination in the Telinga language, and the former part of it is probably derived from अर्य्य, "a man of the mercantile caste." सत्र has been generally found used in the sense of a confectory for the charitable supply of provisions; but I consider this rather inconsistent with the notion of a temple; hence the translation given. आलमनोय I have rendered as if आरमनोय, as the ल and र are sometimes convertible into each other; but it may be for आलम्बनोय.

No. II.

मङ्क करस वधुकस पुतस म[ङ्क] रस
सिवपिरीतस देयधम लेण.

*Translation.*

The religious assignation of a cave (Lena) by S'ivapríta, inhabitant of Mangka, son of Vadhuka, inhabitant of Mangka.

*Notes.*

I cannot at present learn anything of the village here mentioned: the name means "the head of a boat," if the second syllable is correctly given. The name of the donor denotes that he was a convert from S'aivism.

No. III.

मद्दातोयस षाडकरस सुदसणस
रहुनय विजय निकाय देयधम लेन.

*Translation.*

The charitable assignation of a cave (Lena) to the venerable, victorious body, by Sudar'sana, inhabitant of Salsette (Sashṭi), situated on the ocean (brink).

*Notes.*

There are some difficulties in this inscription; as, for example, one in the first word, and another in the word रुहुनय. Whether this should be derived from अर्हनीय, as I have done above, or from the root रूह, "to advance," I cannot determine. साड, and in the fifth No. साट, I suppose to mean Salsette, called by the Brahmans Sashṭi. The whole of the last six words I suppose united in one compound expression, as far as construction goes. The concluding symbol resembles some of those we met with at Junir, as in Nos. VI. and X., but is more of the form of the Gopadma, or "cow's hoof," a lucky figure among the Bráhmans.

No. IV.

करहाकडक [रस] लोहवणयीयस मोहिकस
देय धम लेण

*Translation.*

The religious assignation of a cave (Lena), by Mohika Lohavarṇaníya, of the town of Karhákaḍa.

*Notes.*

There is a town on the Krishná, nearly in a direct line south from Sattara, called Karháḍ; perhaps this may be the town meant. The meaning of the surname is iron-coloured. If I could, I should like to read लोक वर्णनीय "worthy of the people's praise." Perhaps there may be some mistake in the copy of the fac-simile, or in the original; or in some provincial dialect the ह might have been substituted for क.

No. V.

महा भोजीय साट गेरीय विजयय पुत[स] । महभोजस मंडवस खंडपालिन स लखक । सुलासदत्त पुतस उतरदत्त पुतसच । सिवभूतिस सह भयंयनंदय देय धम.

*Translation.*

A religious assignation to the venerable, joyful (company), by the guardian of the mountain passes, the great proprietor Maṇḍava, son of the great proprietor of the Salsette mountains Vijaya, and by Lakhaka (the painter or writer), son of Sulasyadatta, and also Sivabhúti, son of Uttaradatta.

*Notes.*

The first word, according to the Bráhmans here, is used synonimously with Maharája, though it is not common. I consider here

साट equivalent to साष्टी. There is some doubt about the arrangement of this inscription. Each line has a break in the middle; and the question is, are we to return from that point, or read on? But it does not seem of much importance which way we do. I have taken खंड, or, as the Maráthas often write it, खिंड, in the Maráthi sense. It differs from a ghaut (घाट) in that there is no ascent of consequence, the mountains opening so as to enable you to pass straight on. It is not, however, unlikely that खंड may be taken in the sense of division or district, and the meaning be that he was one of the provincial governors. I have also taken पालित in the sense of पालयता. In No. IX., where several of these words again occur, a different rendering is given of some of them; to that number the reader is therefore referred.

## No. VI.

ममक वेजियस वेजस इसिरखितु पासकस पुतस वेजस सोम देवस देय धंमंलनं पुतसच सनागस इसिरखितस मिवघाससच द्रुहृतायच सइसिपालिताय पुसाय धंमाय सहाय च

*Translation.*

To the victorious (company) acquainted with the essence of things, the religious assignation of a cave (Lena), by the noble Somadeva, son of the noble devotee Rishirakshita.

Also by the sons of Rishirakshita Sonaga and Sivaghosha, for the benefit of Duhrita, and also Rishipalita, to promote religion and sociality.

*Notes.*

This inscription is divided into two parts, and in the second part, either the construction is uncommon, or there is something awanting. I have given what I deem the sense of it. The first word I have derived from मर्म. The curious word वेज seems to be the Prácrit of वैज्य, in the sense of वाज्य, "of a good family," from वाज. If this be objected to, it must be taken as a contraction of विजय, similar to the modern जो. The word पुसाय is considered to be the dative of a masculine noun, derived from पुष, and to mean the same or something near पुषा, "cherishing."

## No. VII.

देय धर्म्मय शाक्य भिक्षु
वुद्ध स्त्रियस्य मातापित्रे
अर्ब्ब गाम कखा तटाक चया
दता पुत्यतर्भवभ्य सर्व्व सङ्ख
नाम व्यर्त्ति रजाता वाह्य ये

*Translation.*

A religious assignation, for the benefit of the father and mother of the Sákya mendicant Buddha S'ri, of the village of Arva, along with its tanks and public buildings, given to those pure in heart, who are outwardly free from strife, distress, and pain.

*Notes.*

This inscription approaches very near to the Sanscrit, although it does not seem quite pure; thus कखा, "a boundary wall," should be कख्या; also ग्राम, ग्राम; and if I mistake not in the next line we should have पूत्यनन्तर्भवद्भ्यः The type of the letters in this inscription is more modern than any we have had, especially in the bending down slightly of the *kána*, or mark for the long *a*. The Buddha S'ri of this inscription is more probably some devotee of that name, than Buddha himself. I cannot learn that there is now any village of the name here given.

No. VIII.

सिद्ध. थेराण भदत पा[लि] तमितान भदत
अगिमितन च भागिणेयिय पाव
थिनिकाय पद्ममनिकाय देय धम
लेण पोढिच सह अतेवासिनिय बेधिय
सहच अतिवासिनिय असल्हमिताय

*Translation.*

To the Perfect One. The religious assignation of a cave (Lena), and a cistern to the Theros, viz. the venerable Pálita-mitra, the venerable Agni-mitra, and his sister's son, the purified Duhrita the astrologer, and the purified Padmanika; along with the disciple Bedhya, and along with the disciple Asalha-mitra.

*Note.*

This inscription is so plain, that no remark seems necessary, except to notice, that in reference to the two highest dignitaries the plural is used for the singular number.

No. IX.

महा भोजिय साट गेरिय विजयाय पुतस महा भोज सामंदवस खंडपालितस उपजोविनं सुलासदतस उतरदतायच पुतानं भातूनं लेखका सिवभूति सुकनेठ स सिवमस देय धंम लेनं सह भयाय विजयाय पुत्रानंच ससुलासदतस सिवपालि तस सिवदतस सपिलासच सेलरपकम दुहुतुन ससपाय सिवपालिताय सिव दतय सुलासदतायच थंभो

*Translation.*

The religious assignation of a cave (Lena) by the Secretary S'ivabhúti, intent on emancipation, and most blessed, for the dependents of the strong-armed prince Khandapálita, son of the strong-armed Vijaya, of the Salsette hills, and the sons and brothers of Sulásadatta and Uttaradatta.

Also a pillar has been erected to the sons of the venerable Vijaya, along with Sulásadatta, S'ivapálita, S'ivadatta, Sapila, and also Sailyarupakama, and Duhrita, and for the associates of S'ivapálita, S'ivadatta, and Sulásadatta.

*Notes.*

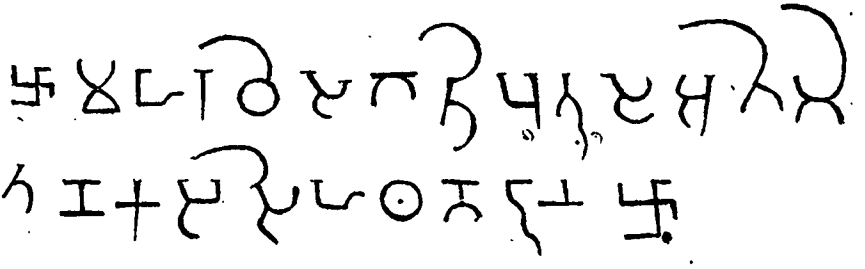
I have here translated Sámandava as if it were Sámanta, and made Khandapálita a proper name. In No. V. I made the former the proper name, and translated the latter, but I think now that this is the better way; yet it is not a matter of much importance. This person was probably a ruler over the Concan, either in the latter times of the A'ndhra dynasty, or after its extinction. The style of the letters point to that period, as well as the political state of the country.

N. B.—There still remain several important Sahyádri inscriptions, of which fac-similes have not been executed by Mr. Brett. Of these the most important is that which exists in a cave at the head of the Náná Ghát. A fac-simile, however, of this, was taken by Colonel Sykes, a copy of which will be found in the Jl. Royal As. Soc. of Great Britain and Ireland, vol. iv. p. 288. The initial invocation to Buddha is obliterated; that to Dharma remains; then follow invocations to Indra and other Hindu gods, as before noticed (p. 7). Near the end of the first line we have the word Kahápana, so often used in these inscriptions for the piece of money given in charity to mendicant priests. It occurs again at the end of the ninth line, and also near its beginning, according to a copy I myself took some years ago. In the second line the word Dakhan, "South," occurs; and in the third Ságara-giri, "Ocean-hills," intended probably as a name for the whole chain; also a certain Maráthi "great warrior," who probably had the charge of the construction of the cave and the keeping the ghát in repair, is named.

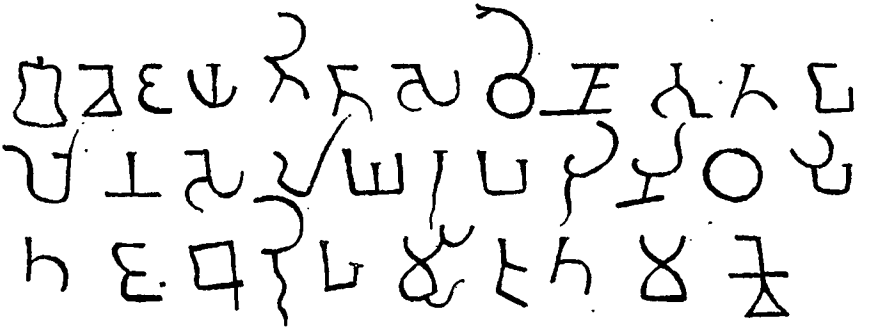
In the fourth line, or third line of No. V. of Colonel Sykes' fac-similes, we have a great many high-sounding titles, which belong, I conclude, to the sovereign by whom this alms-house was constructed. This line in Devanágari is as follows:—

INSCRIPTIONS
FROM THE CAVES AT KARLÉ. N.
*REDUCED FROM IMPRESSIONS TAKEN BY*
LIEUTENANT F. P. F. BRETT.

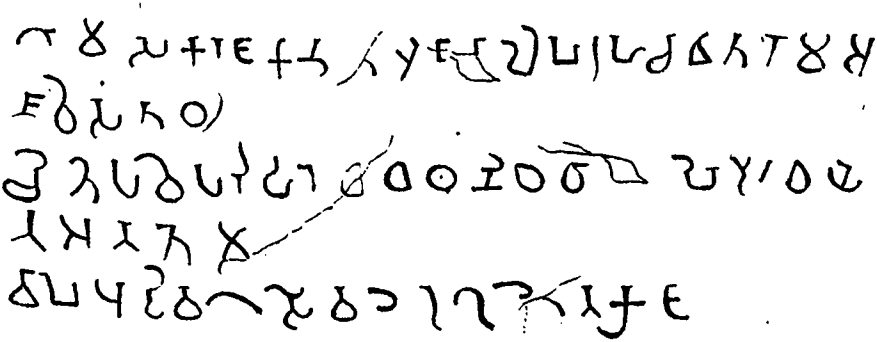
I.



II.



III.



IV.

1.

2.

3.

KARLE. N.

KARLE.N

VI.



VII.



KARLE.N.

VIII.

IX.

X.

XI.

XII.

XIII.

XIV.

XV.

XVI.



XVII.



XVIII.

# INSCRIPTIONS
## FROM THE CAVES AT RORAH SOUTH CONCAN
## REDUCED FROM IMPRESSIONS TAKEN BY
## LIEUT. F. P. F. BRETT.

I.



II.

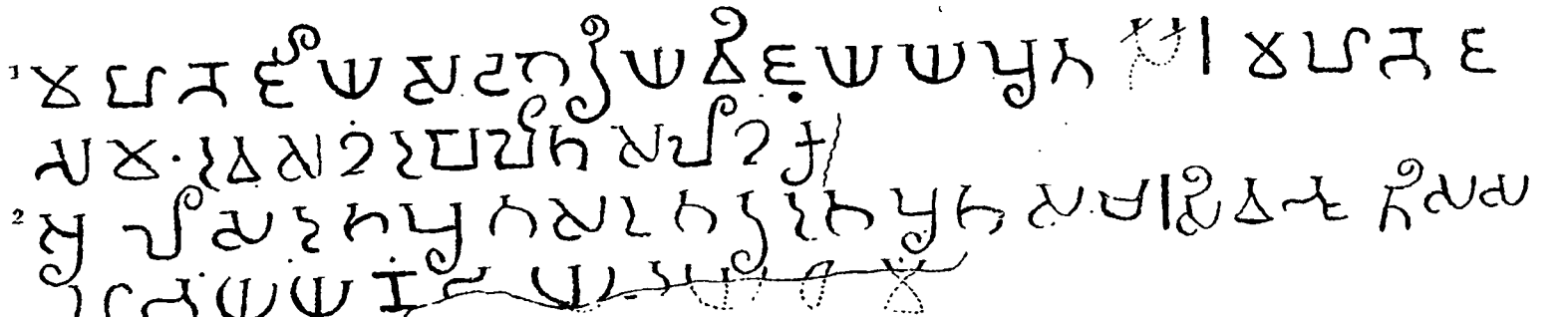


III.

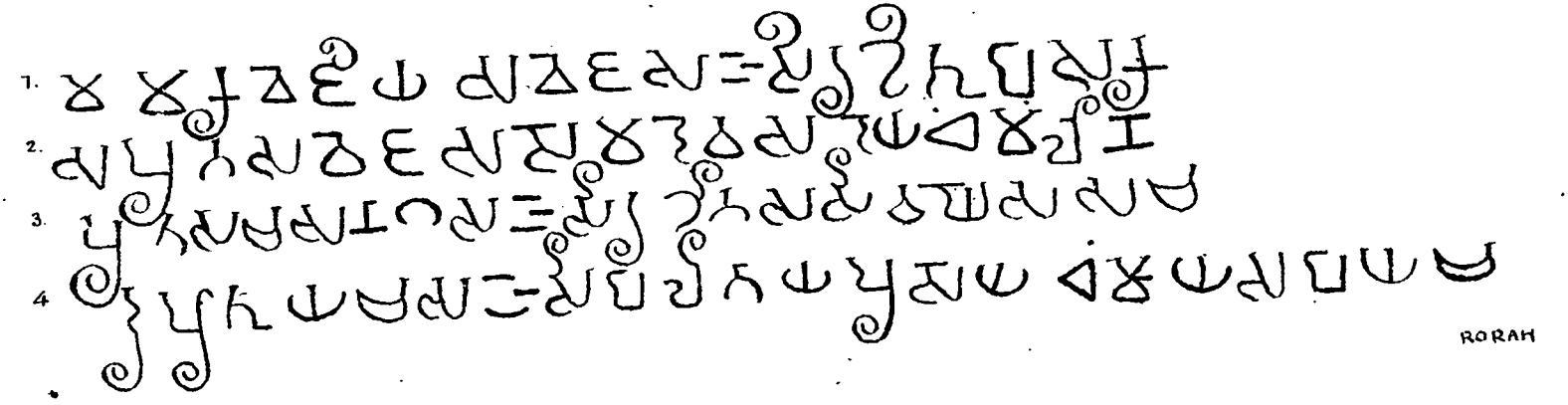


IV.

V.



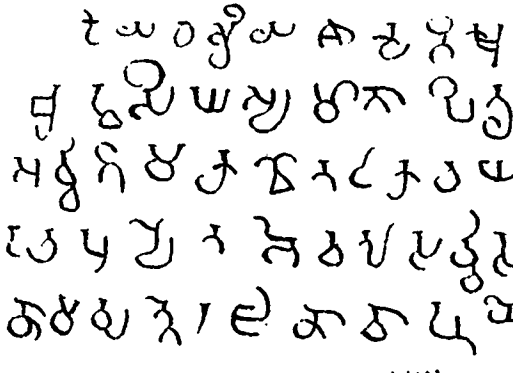
VI.



RORAH

VII.

*Under an Image of Buddah.*



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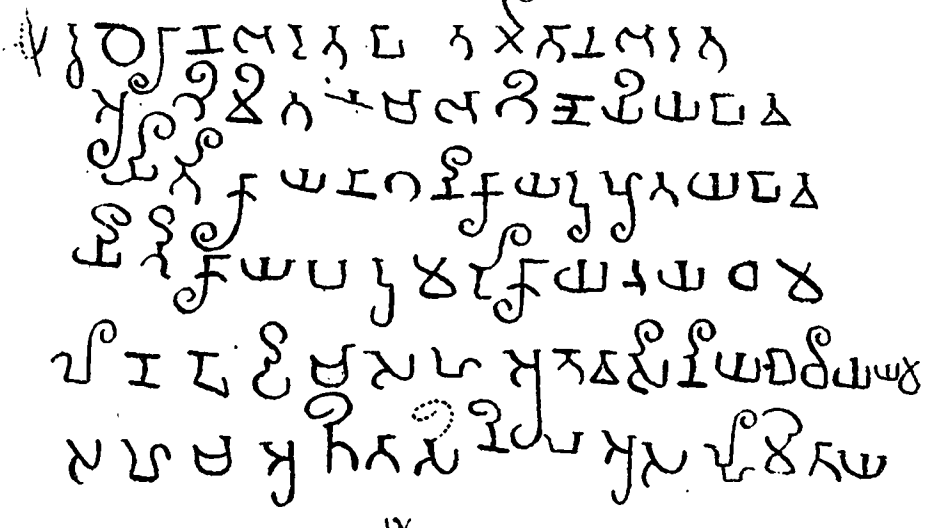

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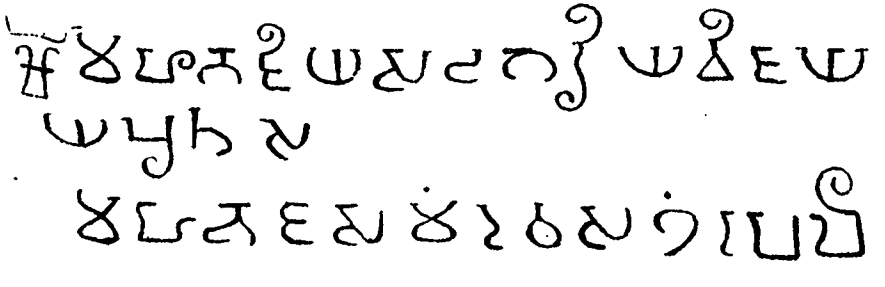


RORAH.

RORAR

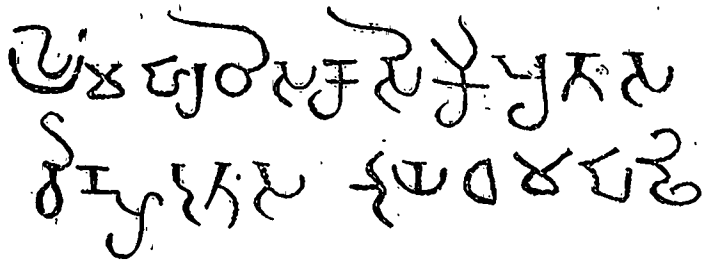
INSCRIPTIONS

FROM THE CAVES AT BAJA

*REDUCED FROM IMPRESSIONS TAKEN BY*

LIEUT. F.P.F. BRETT.

I.



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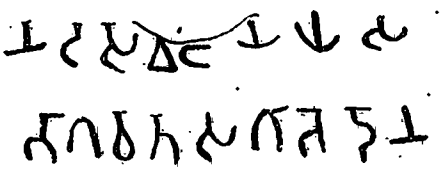


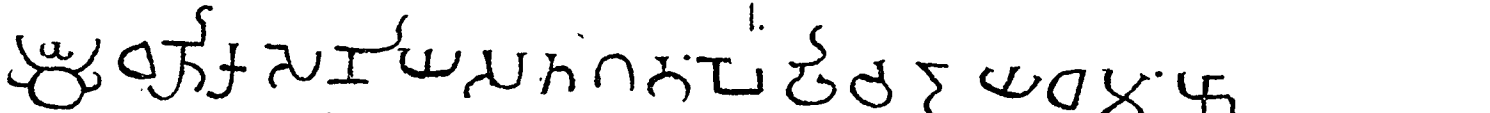
F.D.J.

BAJA.

INSCRIPTIONS

FROM THE CAVES AT JUNIR. REDUCED FROM IMPRESSIONS TAKEN BY LIEUTENANT F.P.F. BRETT.

I.



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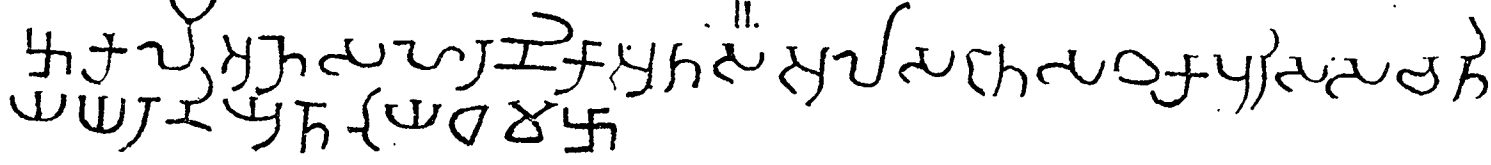

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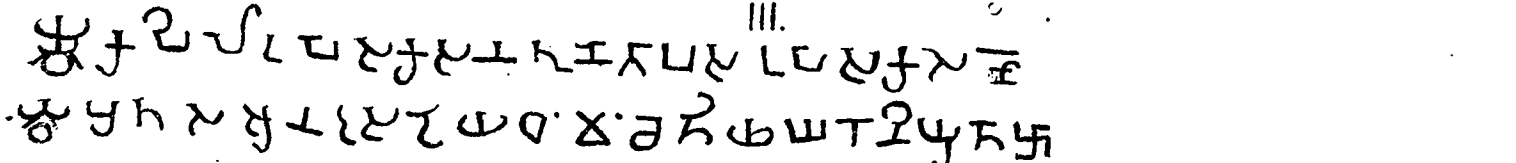


IV.

V.

VI.

VII.

VIII.

JUNÍR.

JUNIR

XII.



XIII.

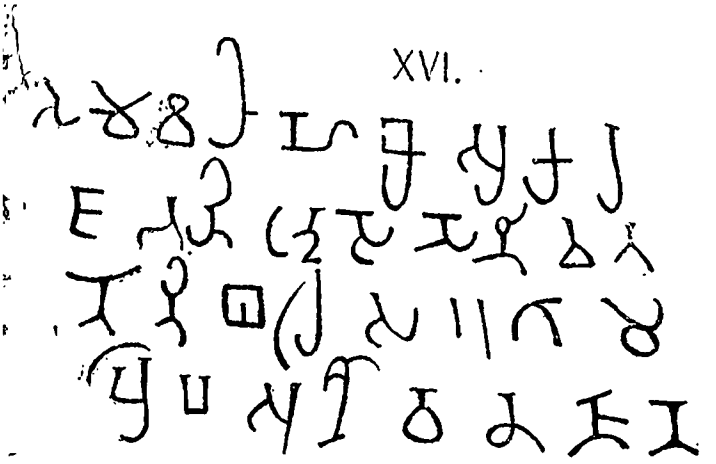


XIV.



XV.

XVI.



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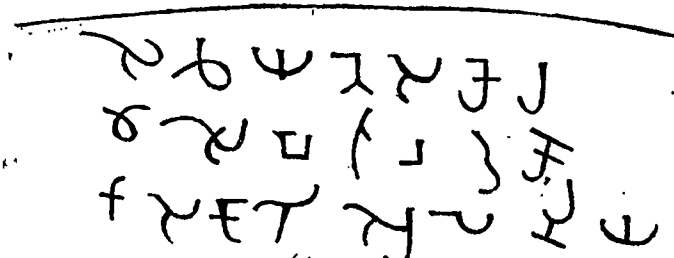

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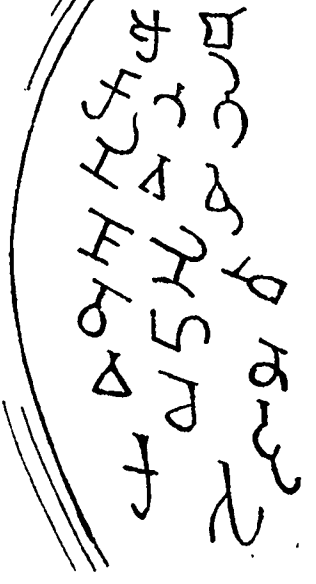

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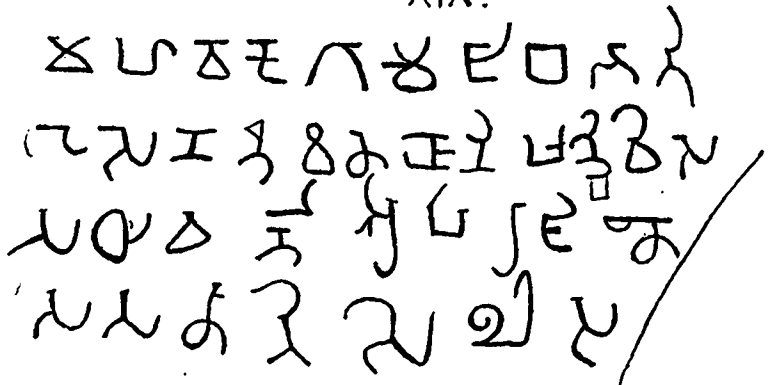

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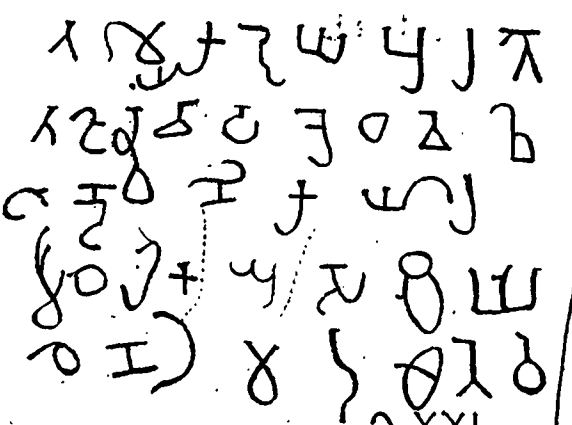
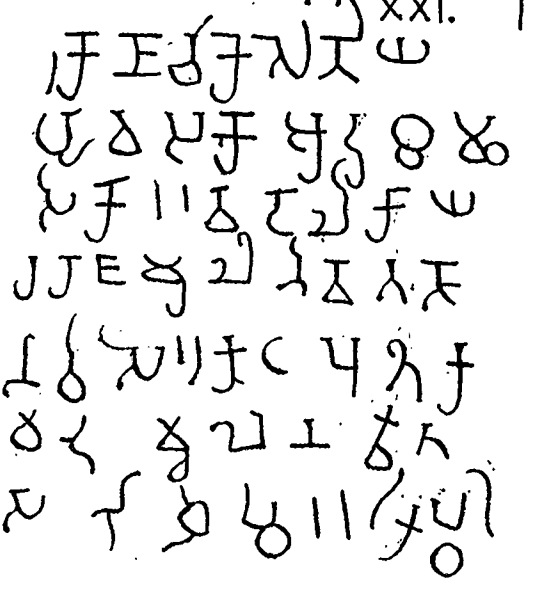


XXI.



XXII.



XXIII.

XXIV.



XXV.



XXVI.

# PLANS of the SOUTHERN CAVES

PLAN of the NORTHEN CAVES.

A

PLAN of the CAVES in the HILL FORT

B

PLAN of the WESTERN CAVES.

C

## INDEX to the PLANS

### NORTHERN RANGE

**A**

These caves are situated to the north of the Town of Junir on the Solomary hills and consist of Cells with Couches, Pillars and Halls.

| | | |
|---|---|---|
| 1 | Hall nearly 30 feet Square with 4 Cells. | 6 |
| 2 | Inscription No 1 here in the vestibule of this cave the roof of which are destroyed. | 7 8 9 10 |
| 3 | Water Tank. | 11 |
| 4 | Cell like with the roof and verd and ribbed with stone supported by 16 Pillars 6 of which are plain, the others have groups of Animals sculptured on their Capitals. | 12 |
| 5 | Inscription No II in the vestibule of this cave. | 13 |
| 6 | Large Hall 51 feet above level of the Caves reached by a Flight of Steps | 14 |
| 7 8 9 10 | Three rows of various cells known as Nos 7 8 9 & 10 the number of cells varies from 12 to 15 | 15 |
| 11 | Plain Cell with a Pillar in front. | 16 |
| 12 | Inscription No III in the vestibule of this Cave. | |
| 13 | Beyond the there are some broken cells two of which have Inscriptions No IV and V are engraved Cells 12 & 13. | |
| 14 | Inscription No VI engraved on the Front of one of them. | |
| 15 | We made of walling to shew where the Cells is about to be of their being the usual with Verandahs. | |

### CAVES on the HILL FORT

**B**

| | | |
|---|---|---|
| 1 | These are situated on the Steep of the Hill Fort and are of one principal series. | 1 |
| 2 | Besides several detached cells | 2 |
| 3 | No 1 cave has only Cells and none of the latter contain any inscriptions. | 3 |
| No 1 | Over the cave there was an inscription but too much effaced to be worth copying | 4 |
| 2 | This is a Cave with Cells | 5 |
| 3 | Having with a flat Ceiling which of pairs to have been painted. Inscription VII is on the front of the temple. | 6 |
| | Cave with 3 Cells and a Pedgod in relief between those facing the entrance. | 7 |
| | Cave with 13 Cells between the Cave & Hall over the water tanks is a 14th Cell. | 8 |
| | Cells like the last is Pedgod in relief on the left & Inscription No VIII. Over the door of the latter of the 2 last have been effaced. | 9 |
| | Cave | 10 |
| | Cave | 11 |
| | Cave | 12 |
| | Cave | 13 |
| | Cave | 14 |
| | Cave | 15 |
| | Cave | 16 |

### WESTERN RANGE

**C**

| | | |
|---|---|---|
| No 1 | Square temple with one small cell to the left | 1 |
| 2 | Cell turned into a temple the veranda to the Goddess Rohini. | 2 |
| 3 | Greater Chaitya with a Dagoba supported by 18 Cells. "Manuel Miller" | 3 |
| 4 5 | 2 Caves under 3 Cells 5 Cells | 4 |
| | This Temple contains no inscriptions. The face of the Altar on which they have been excavated has been worn away by the action of falling water leaving no trace of the Inscription. The inner Hall of the Cave remaining the Aspect of the containing the Temple has a Cell like Hall here built for the use of a Priest before the Caves. | 5 |

### SOUTHERN RANGE

**D**

| | | |
|---|---|---|
| 1 | Small Cell Unfinished. Chaitya | 1 |
| 2 | No 2 Cell above the level of the Chaitya Temple which above area number of Cells filled with earth & Cells. | 2 |
| 3 4 5 6 | Cave with 4 Cells above which there are several Cells & Pedgod & Inscriptions on these Caves. | 3 4 5 6 |

**E**

| | | |
|---|---|---|
| 1 | Cave filled with earth. Inscription No I on the right of the Cave. | 1 |
| 2 3 4 5 | Cells also filled with earth. Inscription No II between the doors of Cells 2 & 3 and XII between 4 & 5. | 2 3 4 5 |
| | Unfinished Chaitya with 18 Cells & having its Verandah supported by 2 Pillars & the 18th centre one of which on the Front is inscribed XIII and the other Inscription IV over the entrance of which have been an elevation. Stone we... | |

Inscription No I XI XII XIII XIV XV XVI and XVII had great difficulty in taking impressions of copy of these which are worn by the small rainwater dashed & the Cells which are there are 15 Caves filled with earth.

There is another set of Caves named the Nine by the Hindus & Dagoba. For moderate ascent small distance to the Inscriptions IV and XIII. Caves to the right & left of the Inscriptions of ancient Hindu Cells to be taken of them.

The Sketch Plan is intended to show the situation of the different range of Caves

W. F. Vere Inv. & Lith.
VI. Between two Cells
Printed at J. F. Brett's print
5th Dec. 1852.

# PLANS of the CAVE-TEMPLES of JUNIR

वारिसावरिय देवस पुत दसवर दसकाम दसधम दसवेदी सिरिमत सासि नो सिरिमत सावमंत. सोम.

Colonel Sykes' copy differs from mine in not having the first syllable, and in having in the fourth भ for व. The word दसधन, also, differs slightly. Then, again, mine wants the last word, which I have supplied from his. After this there is a large blank, where the letters are wholly obliterated. The type of these letters is so entirely the same as that of the Láth inscriptions, that they must belong to the same era. On this account I am tempted to conjecture that the name Várisávariya is the Vindusára of the Puráns, and the Bindusáro of the Buddhists, whose name Várisára in the Bhágavat is essentially the same as ours. This, then, is the father's name; the word S'ántin is probably an epithet, though S'ánti is the Jain name for one of the Magadh emperors. The word सावमंत is probably सामन्त or सम्राट्. The obliterated letter may be अ; and the last म, as the letters are there indistinct, may be a mistake for क; thus giving us A'soka. I would then translate "The son of the divine Vindusára, possessed of tenfold endowments, tenfold loveliness, tenfold wealth, and tenfold knowledge, the fortunate auspicious, the fortunate imperial A'soka." It is very provoking, however, that the inscription should fail us in the very place where it becomes most interesting. It would certainly be gratifying if we could certainly identify this as one of A'soka's numerous monuments; still I conceive, all things considered, we are warranted to draw this conclusion.

There are also two inscriptions known to exist near Mahad (Mahar), in the Concan, and given in Dr. Bird's work, of which we have not got fac-similes. They evidently belong to the Kuḍen (Korah) series. There are also inscriptions at Adjanta, in a much more modern character, accurate copies of which are still a desideratum.

## Chronological Summary.

I shall now conclude this paper with a short summary of the chief events mentioned in the Sahyádri inscriptions, in chronological order. It will be sufficient reference merely to note the page of this, and of my former paper, on which the statement made is founded. The dates which have not been ascertained from inscriptions, but merely made out by calculation, are marked with an interrogation.

| B. C. | | Page of former Paper. | Page of present Paper. |
|---|---|---|---|
| 200? | A cave was excavated, and an alms-house established in it, on the top of the Náná Ghát, by an Emperor of India, probably A'soka, the first Buddhist Emperor ..... | | 174-5 |

| B. C. | | Page of former Paper. | Page of present Paper. |
|---|---|---|---|
| 70? | The Great Cave Temple at Kárle*n* was formed by the Emperor Devabhúti, under the superintendence of Xenocrates, a Greek | 4, 11 | 152-3 |
| 65? | A small cave was excavated at Káṇheri by the same Xenocrates, in which a supposed tooth of Buddha was deposited, till it was removed to an adjoining tope, as mentioned below. | 20 | |
| 23? | The expedition of the constructor of the cave mentioned below into Malabar, to quell an insurrection there, took place | 40, 49 | |
| 22? | The central or Satrap cave at Násik was excavated by Ushavadatta, son-in-law of the Satrap Nahapána, of the Parthian monarch Kshaharáta (Phrahates?) | 40, 49—53 | |
| 20? | Lands were given to the monks at Junir, who dwelt in the third series of southern caves, by several individuals, and especially by S'isuka, called there S'risuka, the first A'ndhrabhritya sovereign, while he was yet only prime minister | | 165-7 |
| 15? | The Great Temple Cave at Káṇheri was probably excavated by the same monarch, after he ascended the throne. The name given him above is that of the Matsya Purán; here he receives the name of Balin, that given in the Bhágavat.. | 27-8 | |
| A. D. | | | |
| 189 | A tope or mound was constructed at Káṇheri to contain the tooth of Buddha, mentioned above, and also in honour of a celebrated Buddhist devotee, by Pushyavarman, who was connected with the A'ndhra royal family | 13, 33 | |
| | N. B.—This is the tope opened by Dr. Bird in 1839, and which contained a plate with the date on it. | | |
| 326 | The village of Karanja, on the Ghâts, was made over to the monks at Kárle*n*, by two great military commanders, who in the struggles between the regal Satráps and Magadh Emperors had most likely wrested the adjacent territory from the former, and afterwards resigned it to the latter. About the same time, also, the image of Buddha, on the left of the entrance, where these inscriptions are found, was probably executed | | 153—155 |
| 337 | The large cave most to the left of those that contain inscriptions at Násik was excavated at the command of the queen of Gautami-putra, described as lord paramount of India and Ceylon, and who had established in his capital a college for Brahmánical, and another for Buddhist science, an institution for teaching archery, and a hospital | 36, 42 | |
| | N. B.—Reasons have been adduced to show that the era mentioned in this inscription is the Balabhi, and that it was established in commemoration of the overthrow of the Græco-Parthian empire in Western India, by | | |

| | | Page of former Paper. | Page of present Paper. |
|---|---|---|---|
| | the united forces of the Magadh Emperor and the Balabhi Commander-in-chief, who rebelled against his sovereign, the reigning royal Satrap, and rendered himself independent. These Satraps had, in all probability, reigned for a long time in their own right, and had prefixed the title regal to their former appellation, to point this out. The latest date on any of their coins is Samvat 390, or A. D. 333; for I think, from the form of the letters, that the era must be the common Samvát. We have, then, only to suppose, that on the Indus their government subsisted fourteen years after it was overthrown in Gujarát, as the Balabhi era commences with A. D. 319. In accordance with this supposition, none of the 400 regal Satrap coins that were found at Junir in 1846 belong to the two last Satraps. The vaunting, too, of Rudra Dáma, the last of them but one, on the Girnár inscription, over the S'atkarni ruler of the Dakhan, our A'ndhra monarch, could refer only to some partial success preceding the final catastrophe, as we usually find people boast most when hardest pressed. From our inscriptions it is evident that the hills in which the caves are excavated were sometimes in possession of the one, and sometimes of the other party. | | |
| A. D. | | | |
| 342 | The monastery cave at Kárlen was executed by a mendicant devotee ..... | 36 | 158 |
| 410? | Buddhaghosha, the author of the Páli work called in Ceylon the Atthakatha, and the Buddhist apostle of the Burman peninsula, set up a middle sized image of Buddha on the right porch of the great Temple Cave at Káṇheri .. | 13, 14 | |
| 428? | During the reign of the A'ndhra monarch Yadnya S'ri Sát Karṇi, who is mentioned in the annals of China as having sent ambassadors there, a nephew and other relations of his set up the two colossal images on each side of the porch of the same great cave; and at the same time a village was given to the monks ..... | 26 | |
| 430? | Other relations of the same emperor established an almshouse in connection with a cave at Káṇheri..... | 24 | |
| 431? | Others of the royal family established a refectory in connection with another cave there ..... | 22 | |
| 433? | A monastery-cavo was excavated at Násik by command of the wife of the commander in chief of the same Emperor .. | 13, 56 | |
| 460? | A temple cave at Kuḍen (Korah), in the Concan, was excavated by the Secretary of the Chief of Salsette, who seems to have exercised authority over a considerable adjoining district of country ..... | | 171, 174 |

N. B.—The above mentioned works are all that appear to me to derive from the inscriptions probable indications of the period about which they were executed, whether by means of the dates, or the names they contain. The time when the others were engraved can only yet be guessed at from the style of the letters, but none seem to me to have been inscribed on the Sahyádri rocks at a later period than that last mentioned, and certainly none earlier than the first date here given, bringing them all within the two centuries preceding, and the five succeeding the Christian era, during which time Buddhism flourished in Western India, while the modern Hindú system was silently moulding itself into its present form, and preparing to take the place, at a somewhat later period, of the religion of Buddha, and to exhibit that compound of Vedic pantheism, Buddhistical tenderness for animal life, and indigenal superstition, that is now current in India. During, however, the whole period of the Buddhist ascendancy, Brahmáns existed, studied their literature, had their holy places, and performed those of their rites that could be performed in private. The common people also worshipped Krishna, Bhaváni, and S'iva, as local gods, in particular districts.

The travels of the Chinese Fa Hian show, that at the beginning of the Fifth Century Buddhism prevailed throughout India; and those of Whang Thsang show that this was still the case in the beginning of the Seventh Century. An inscription, of date A. D. 657, originally affixed to a Buddhist temple near Nagpore, shows that it still prevailed in the East at that period. (Jl. Bom. Royal As. Soc. vol. i. p. 150.) It is to be noticed here, also, that there is a discrepancy of 42 years between the date A. D. 342 and A. D. 428.

## *Errata.*

Without noticing mere obvious typographical errors, the reader is requested to correct the following mistakes in this and the preceding paper:—

Page 3, line 3 from bottom, *for* "erected" *read* "bestowed as a gift"
„ 4, „ 12 „ „ *before* "Commander" *insert* "wife of the"
„ 7, „ 11 from top, *for* "Apsaras)," *read* "serpents),"
„ 32, „ 9 from bottom, *before* "p. 97;" *insert* "vol. x."
„ 33, „ 14 „ „ "श्रावक" is translated "lay disciple," which is the Jain sense; but in Buddhist literature it means an order of the priesthood; the preceding word, "Agrya," also, may be a proper name.
„ 52, „ 8 from top, *for* "a thousand milions:" *read* "a thousand and a million:"
„ 153, „ 2 The word "Bhúti," should be in brackets, as it is supplied. In the Prácrit inscriptions ञ is sometimes changed to ञ्ञ, and sometimes to न्य, according as the word in its Sanscrit form requires; but neither of these syllables occurs, except in the Sanscrit inscriptions: where either of them is found in the Prácrit, the original is ञ.

ART. II.—*Summary of the Geology of India, between the Ganges, the Indus, and Cape Comorin.* By H. J. CARTER, Esq., Assistant Surgeon, Bombay Establishment. [With Map and Diagram.]

Presented August 1853.

IT is but a few years since that the late Captain Newbold, of the Madras Army, wrote his "Summary of the Geology of Southern India," which was published in vols. viii. xi. and xii. of the Jl. of the Royal As. Soc.; and certainly no one has ever preceded or followed him in India whose opinions are entitled to so much respect, from his general geographical and geological knowledge, his active powers of observation, and his great personal experience of the country about which he has written. It is to be regretted, however, that he did not include that part of India between the Ganges and the Indus; because, with his actual acquaintance with the former, and the published observations on the latter, he might have drawn much more faithful and useful comparisons between the two than one behoving almost entirely to the observations of others for a summary of both.

As it is, there is nothing left but a careful perusal of all that has been written, directly and indirectly, on the subject, for at least the last twenty years, with frequent reference to a museum of authenticated specimens, before the student can feel himself master of what has already been done, and enabled to proceed with confidence to further investigation.

Very few, however, possess such opportunities, although there are hundreds so situated in India, who, if they could be conveyed to them, would not only be able to examine their respective localities efficiently, but be most grateful for the means thus afforded of additional occupation.

Feeling sensible of this, at the same time that it is impossible to transfer such advantages in bulk, I have endeavoured to supply their place, by giving a short summary of all the principal facts and

conclusions to which an attentive study of the observations of others and my own limited experience on the subject have enabled me to arrive, wishing that this long desired compilation had been undertaken by a more competent person.

The part of India I propose for our consideration is comprised within the Ganges and Jumna on the NE., the Indus and Sutlej on the NW., the Bay of Bengal and Arabian Sea respectively on the E. and W., and Cape Comorin on the S.; cutting off, however, that angular portion which is NE. of a line extending from Delhi to Ferozepore, as this would entail a description of the geology of the sub-Himalayan range, which, besides rendering the subject much more complicated, and being almost entirely without the natural boundaries of the tract mentioned, I am not prepared to enter upon.

With the general geographical features of this tract I must presume that the reader is already acquainted, and, therefore, shall only add a small map, to facilitate his finding out the places and localities to which I may have occasion to direct his attention.

Numerous as the geological observations on the portion of India before us appear to be, there are still so few, comparatively speaking, of general bearing, and these on localities so widely separated, that, after having perused many hundreds of pages, the student finds himself barely on the threshold of his subject, and with but a faint sketch even of the most prominent geological features of the country he at first thought so well known. Such, however, must always be the case in an attempt to generalize from unconnected facts and data indefinitely described, which most of these are. Yet India has not been without her able, faithful, and devoted geologists; but the treachery of her climate, her uninhabited wastes, where her rocks are best seen, her extensive and impenetrable tracts of vegetation, and her stratified formations metamorphosed and unfossilized by the intense heat of repeated intrusions of igneous matter, have, all combined, opposed the development of her geological history, and the former sent many an efficient enthusiast to an early grave, ere his task of practical examination had hardly been commenced.

The progress of Indian geology is, therefore, necessarily slow, and its advancement now almost impossible, without a previous knowledge of what has already been done; which, however much more advantageously obtained by personal observation in a temperate climate, with an abundant and highly civilized population, will not admit of a similar exchange in India, where the uninhabited and unhealthiest parts are

generally the most instructive, and can hardly be expected to be visited more than once by the same individual.

Limited, however, as our actual acquaintance with the geology of India may be, there is still enough to shadow forth a systematic outline of what really exists, and which, if learnt, may materially facilitate the further development of her mineral and geological resources.

It will hereafter be seen, that in the tract mentioned we have, at least, representatives of all the geological series of Europe, from the Oolitic period down to the present time, with metamorphic strata, and plutonic and volcanic rocks in abundance, such as are to be found in other parts of the world. So far, the Oolitic deposits appear to be the most interesting, both in an economical and in a geological point of view; for they not only contain the coal beds of India, iron-ore, and a very fair lithographic limestone; but in their metamorphic state appear to afford the white marble of India, which, together with the red coloured sandstone, another part of this series, form the chief materials of the Taj Mahal at Agra, and the latter that of all the principal buildings of the towns on the Jumna from Mirzapore to Delhi. At Ajmeer and elsewhere the same sandstone, apparently metamorphosed, yields lead; copper is found in the shales of this series; serpentine in Bahar; steatite (pot-stone) in many places; magnesite near Jubbulpore, &c.; and the researches of Captain Franklin and Jacquemont in Bundelkhund, and Voysey in Southern India, would seem to show that the original conglomerate, if not the real bed of the diamond and a part of, at least almost invariably accompanies, this series. While the late discoveries of the Rev. Messrs. Hislop and Hunter in the neighbourhood of Nagpore have shown that the Oolitic deposits abound in by far the most interesting fossils that the interior of India has yet afforded.

The so-called cornelian mines, again, at Rattanpore, about 42 miles inland from the mouth of the Nerbudda, would appear to be in an old beach, chiefly formed of rounded flints from the amygdaloidal rocks. But these and other conclusions had better be given in connection with the facts from which they have been derived, lest the mind of the reader be biassed in anticipating that which, after all, may prove to be fallacious; the object of this summary being, not so much to insist on the correctness of the views it may contain, as, in the absence of more extended data, to place something before the reader which may draw his attention to the subject.

With this short introduction, let us proceed at once to the description of the different formations, commencing with the oldest, and ending with the most recent. These will be separated into Groups, headed respectively with a tabular view of their contents.

For authority, the author's name alone will be given, the titles of his publications being inserted at the end of the article; and, when reference is made to a specimen in the Society's Museum, the letters Mm. will precede the contributor's name, likewise P.MS. for private manuscript.

In the spelling of the names of places I am compelled to follow that of the Maps as much as possible.

## GROUPS.

### I.

### PRIMITIVE PLUTONIC ROCKS.

This group is intended for the primitive granitic rocks of India, when such shall have been determined. So far, the observations which have been communicated on the plutonic rocks are, comparatively, so scanty and so unconnected, and in every instance these rocks themselves so intimately mixed up with metamorphic strata, that primitive granite has not been satisfactorily demonstrated, and until this is done we must commence with the oldest *stratified* formations.

### II.

### OLDER METAMORPHIC STRATA.

| | |
|---|---|
| *Gneiss.* | *Quartz Rock.* |
| *Mica Schiste.* | *Micaceous Slate.* |
| *Chlorite Schiste.* | *Talcose Slate.* |
| *Hornblende Schiste.* | *Clay Slate.* |

*Granular Limestone.*

I have called these "Older," in contradistinction to newer metamorphic strata, which also exist in India. They may be generally known by their composition, and by their being frequently veined with rocks of the secondary granitic series.

*Gneiss.*—This rock appears to be by far the most general and abundant of all the metamophic strata. It occurs at Oodeypore (Dangerfield), near Baroda (Mm. Fulljames), Zillah Bahar (Sherwill), Rajmahal hills (M'Clelland), Phoonda Ghaut (Mm. DelHoste), Northern Circars (Benza), more or less throughout the peninsula to the Palghaut (Newbold), and probably to the extremity of India. It forms,

with the other hypogene schistes, the scarp at the falls of Gairsuppa, which is 888 feet, to the water below, and the latter is 300 feet deep (id.). Christie considered this to be primitive gneiss: it is veined by granite (Newbold), which Christie also considered not the oldest. It is also veined by granite at Wallavapore, in the bed of the Toombudra, 35 miles WSW. of Bijanuggur (Newbold), Chittoor, on the Eastern Ghauts, top of the Bisly pass above Mangalore, the Palghaut, Sunkerrydroog, and Bangalore (id.).

It contains specular iron ore (Siderocriste) in most places: western extremity of the Vindhya range (Fulljames), Rajmahal (M'Clelland), in large beds at Malwan, on the Malabar Coast (Malcolmson), and at Hazareebagh is a bed of flinty brown iron ore of a pitchy lustre, and splintery fracture, 20 feet in thickness (Williams *apud* M'Clelland). Graphite replaces the mica at Banuswar near Bangalore (Newbold), Tinevelly, and Travancore (Major General Cullen). Tin is found in it on the banks of the Barakur, within a few miles of the town of Palmow (M'Clelland). Beds of garnets are common in it everywhere, corundum in Southern India (Christie), and beryl in the Mysore (Newbold).

It varies in composition, texture, and colour, containing more or less mica, being more or less compact, massive or schistose, and varying in colour from speckled, black, brown, reddish, to grey and white. It is also tinted green sometimes, when chlorite replaces the mica. When very fine-grained, and decomposing, it bears a close resemblance to fine-grained sandstone.

*Mica Schiste.*—This rock, though not so often mentioned as hornblende schiste or gneiss, is probably always more or less present in parts of the latter. Like it, also, it contains garnets in the Southern Mahratta Country (Malcolmson), western extremity of Vindhya range (Mm. Fulljames), &c. It seems to pass into micaceous slate at the Phoonda Ghaut. Newbold states, that although generally veined with quartz, he never saw a vein of granite passing into it. Being associated with gneiss and hornblende schistes, they of course pass into each other.

*Chlorite Schiste.*—This, like mica schiste, contains garnets in the Southern Mahratta Country, and passes into mica schiste and gneiss, to which it is subordinate: also into steaschiste (pot-stone), massive and laminar, and into chlorite slate, and clay slate. *Talc Schiste* is almost synonymous with *Chlorite Schiste* in geology, though talc and chlorite differ in mineralogical composition. Talc is frequently much more difficult to distinguish from chlorite than the latter from mica, by any empirical character.

*Hornblende Schiste.*—This rock, though not so abundant as gneiss, is just as frequently mentioned. It forms the eastern and western sides of the Neilgherries, where it is from 5 to 7 miles in breadth, and slopes pentlike on either side on the granitic rocks which form the central axis of these mountains (Benza). Like gneiss, garnets are common in it at the Neilgherries (id.), Southern Mahratta Country (Mm. Aytoun), and corundum in Southern India (Newbold), &c. It contains magnesite, and chromate of iron in veins, at Karpur, 4 miles north-west of Salem, and green garnets in quartz veins at Sankerrydroog, about 20 miles SW. of Salem (id.). Actinolitic forms of this schiste are frequently mentioned by Newbold. It is also found with mica schiste on the Malabar Coast, which often passes into it (Malcolmson, and Mm. Aytoun).

*Quartz Rock.*—Commencing in the north, Jacquemont states, in his journey from Delhi to Bombay, that all the hills are composed of quartz from Delhi to Alwar, as well as between Ajmeer and Oodeypore. The quartz of the mountains at Ajmeer is compact and granular, with disseminated mica, and of a violet, grey, brown, or red colour. Tod mentions the summits of the diverging ridges from Ajmeer as being "quite dazzling," from their "enormous masses of vitreous rose-coloured quartz." On the great tract of slates forming the Suloombur range, about half a mile north of Maunpore, a little village situated on its ordinary summit, are two hills from 150 to 200 feet high, composed entirely of compact white semi-transparent quartz, in parts tinged with red, which, from its brilliant white colour, contrasted with the sombre hue of the slates, makes these hills at a distance resemble "snowy peaks" (Dangerfield).

Immense beds of quartz abound, not only in the neighbouring hills, but in all the plains of Suloombur, and towards Oodeypore. From the summit of the mountains round the Deybur lake or Beerpore, rises "an almost perpendicular wall of a large conglomerate or compound rock, consisting of immense reniform, or compressed globular masses of hornstone or quartz, imbedded in paste of the same, but having interposed a large quantity of golden mica in brilliant small plates; thin beds of mica slate occur near the centre of the mountain, with small seams of felspar, and large imbedded masses of Lucullite" (Dangerfield). The brilliant whiteness of the quartz in the Southern Mahratta Country is also spoken of as being very striking, and Christie mentions ranges of hills there which are crested with limpid quartz, from the granite in which it is imbedded decaying on either side. Returning to the north, again, Jacquemont states that he saw a mountain at Alwar composed

of nearly vertical strata of quartz, alternating with thin beds of black amphibolic, or argillaceous, or ferruginous limestone. Around Jaipore and Ajmeer loose micaceous sand prevails, with projecting rocks of white quartz, amphibole, mica schiste, and dykes of syenite; and 4 miles from Chittore a ridge of nearly vertical strata of quartz, resting against granite on one side, and alternating on the other in argillaceous schiste, on which again rests compact limestone. (See Jacquemont's section.) Quartz rock is found at the western extremity of the Vindhya range, associated with mica slate (Hardie and Mm. Fulljames); and at its eastern extremity "in subordinate beds" in "old blue slate," but "mostly occupying a position between the older and newer varieties of slates, stratified," and "reposing on the back of old blue slate mountains in tabular masses, thus forming mountain declivities uncovered by other rocks. A columnar fibro-slaty variety is found between the newer and older clay slate in nearly erect strata, passing on the one side into blue resinous conchoidal quartz, and on the other into the newer clay slate" (M'Clelland). Other hills of slaty quartz and of hornstone in the same vicinity may be referred to the same formation (id.).

Veins and large beds of quartz, more or less amethystine, are present in the granite plains of Hydrabad (Voysey). They occur also more or less throughout the peninsula; but the existence of quartz rock is not so often mentioned in the southern as in the northern part of India: indeed, after crossing the Toombudra, this rock on the western side of the peninsula appears to be subordinate in development all the way to the extremity of India, and micaceous and clay slate never to my knowledge mentioned.

It contains lead at Ajmeer (Jacquemont and Dixon), where both are in a granular form, and iron and copper in the Southern Mahratta Country (Mm. Aytoun). Mica is frequently found in large masses, and disseminated throughout the rock; talc also, and chlorite, occasionally; and there is an extremely beautifully green specimen from the Southern Mahratta Country, coloured apparently with the latter (Mm. Aytoun).

*Micaceous Slate and Chlorite Slate.*—These are but more or less laminar aggregates of fine clay and mica, or fine clay and chlorite, the former rendering the mass more or less sparkling in appearance, the latter more or less satiny and greasy to the touch. They both occur at the Phoonda Ghaut (Mm. DelHoste), and the latter in the Southern Mahratta Country. Micaceous slate also occurs in the Suloombur range (Dangerfield). Both pass into clay slate, when the brilliancy of the one and the greasiness of the other completely disappear. Copper

occurs in a talcose form in the Southern Mahratta Country (Mm. Aytoun), but I am unable to state if it belongs to the old or to the new metamorphic rocks: my opinion inclines to the latter.

*Clay Slate.*—This formation appears to be of great thickness. It is both massive and laminar, and of a variety of colours. Tod states that "the Aravulli range is chiefly characterized by granite reposing on massive, compact, dark blue slate." In passing from the north-western part of Malwa to Oodeypore, across the Duryawud valley, and the Suloombur range, towards the Deybur lake, clay and chlorite slates are almost the only rocks met with for five or six miles. The Suloombur range is found to be almost entirely composed of clay and chlorite slates, in vertical or highly inclined layers, with subordinate beds of greenstone, greenstone slate, and a fine crystalline limestone (Dangerfield); and the great mountain chain which runs nearly in a direction north and south, past the westward of Oodeypore, dividing Guzerat from Malwa, Rath, and Bagur, is, as far as it is known, principally composed of slates and primitive limestone (id.). In the Curruckpore hills, where micaceous slate passes into clay slate, the latter occupies a belt of country 20 miles in breadth, extending across the direction of the strata (M'Clelland). The Nerbudda passes through mica talcose and chlorite schiste, and gneiss, superposed with dolomite between Lamaita and Beragarh, close to Jubbulpore (Franklin); and again, on the south side of the Nerbudda, between Mandela and Amerkuntak, Dr. Spilsbury states that the schistes are like the scales on a Manis' back. Micaceous slate passing into clay slate occurs in the Phoonda Ghaut (Mm. DelHoste), also in the Saltoor pass, in the Southern Mahratta Country (Aytoun). Voysey, in his last journey from the vicinity of Nagpore to Calcutta, *vid* Sumbulpore, mentions "clay stone [clay slate?] in gneiss, in the bed of a watercourse between Kishenpore and Surekeela, just after having passed gneiss, hornblende schiste, and quartz rock, repeatedly alternating," and in alluding to its metaliferous character he adds: "At Calastry it contains led ore mixed with silver; at Nellore copper; at Nagpore manganese and lead ore, and copper; micaceous iron ore is a very common product of this rock." Old clay slate with flinty slate and limestone was seen by Dr. H. [Dr. Heyne?] about the Kistnah (Extracts from Dr. H.'s MS. *ap.* Voysey).

Micaceous and magnetic iron ore occur in clay slate in the Southern Mahratta Country (Mm. Aytoun), manganese in the Kupputgode range, in the same neighbourhood (Aytoun and Newbold), lead in the Eastern Ghauts at Jungamanipenta (Newbold), plumbago in

the branch of the Pulicat hills running south from Cuddapah (Dr. H. *ap.* Voysey). Tod mentions garnets in a hill of blue slate one mile east of Poorna, a little north of Oodeypore; also on the frontier of Kishengurh and Ajmeer; and mines of tin? and copper at Dureeba, close by. Aytoun's ENE. and WSW. section of the Kupputgode hills shows a vast quantity of iron schiste interstratified with chlorite "and micaceous schistes; with talcose quartz, hornblende gneiss, mica slate, and hornblende schiste" on the ENE. side: one stratum of iron ore is 60 feet in thickness. Gold is found in the iron sand of the watercourses running from these mountains, and also from the Saltoor range adjoining, while in the centre of the Kupputgode range are two hills called the "great" and "little" gold mountains.

*Granular Limestone.*—Connected with the old metamorphic strata, appears to be a limestone, though the fact is by no means substantiated, on account of the metamorphosed state of much of the Oolitic limestone of India. Captain Dangerfield mentions subordinate beds of a "finely granular crystalline limestone, of a light grey colour, occurring with greenstone slates in the clay and chlorite slates of the Suloombur range, at Maunpore, between Malwa and Oodeypore"; also "imbedded masses of Lucullite of a black colour, and dull conchoidal fracture," with thin beds of mica slate and small seams of felspar, in mountains of gneiss round the Deybur lake, of the same neighbourhood. Jacquemont saw a mountain of quartz at Alwar, interstratified with thin beds of amphibolic, argillaceous, or ferruginous limestone, in vertical strata. There is a compact finely granular limestone, of a dark bluish-grey colour, associated with mica slate, in the Phoonda Ghaut (Mm. Del Hoste). It has all the appearance of mountain limestone; while a still more compact variety of a lighter colour exists on several parts of the Malabar Coast in the neighbourhood: near the entrance of the Goa river, in very subordinate beds, associated with the chert and slate of that locality (Mm. Dalzell), this would be worth examining more minutely, as it evidently contains the remains of shells. Limestone is found in hornstone slate in the Nulla Mulla mountains; and the lead mines of Jungamanipenta, in the Eastern Ghauts, are in limestone associated with argillaceous and arenaceous slates and shales, "resting conformably on the hypogene schistes," whose age Newbold states is undecided. He also mentions a layer of fine crystalline limestone, apparently magnesian, in gneiss broken up by granite, at Sunkerrydroog, with innumerable garnets in the limestone where it is in contact with the granite. Fine white highly crystalline limestone, with graphite, in grains, disseminated in it, or with masses of green and clove-brown? hornblende, in laminar or

granular crystallization, occur in the district of Tinevelly (Mm. Major General Cullen).

*Obs.*—As with the *Quartz Rock*, so with the *Clay Slate*, and *Granular Limestone*, there is in many instances no possibility of determining which belongs to the older, and which to the newer metamorphic rocks, from the present observations; and they never will be satisfactorily described and distinguished throughout India, until they are examined by a practical geologist, on the spot, well acquainted with Indian geology. There are evidently two metamorphic series, at least; and until their respective minerals and characters are determined, they will be perpetually confounded. I think it extremely probable that I have unavoidably done this, but I must be content to leave future investigation to point out my mistakes; let us now direct our attention to the rocks by which these strata were first penetrated.

## III.

### Secondary Plutonic Rocks.

| | | | |
|---|---|---|---|
| Granitic or Felspathic. | *Granite.*<br>*Protogine.*<br>*Syenite.*<br>*Pegmatite.*<br>*Leptynite.*<br>*Eurite.* | Diallagic .... | *Euphotide.*<br>*Eclogite.* |
| | | Amphibolic or Hornblendic. | *Amphibolite.*<br>*Hemithrene.*<br>*Diorite.* |

### Granitic or Felspathic Rocks.

*Granite.*—Huge masses of a compressed round or cuboidal figure, heaped upon each other irregularly or in columnar piles and erratic blocks, compact, or undergoing concentric laminar decomposition *in situ*, or in detached portions, form the grand characteristic features of this formation in India as well as elsewhere; and as it appears to exist more continuously, and to a greater extent, in the neighbourhood of Hydrabad than in any other district, so its features are, perhaps, more strikingly developed in this than in any other part of India. Voysey states, that on quitting the banks of the Kistnah, granite alone, chiefly of a red colour, is the basis of the country to the Godavery. Red felspar seems to be the predominant ingredient in the secondary plutonic rocks throughout India. The granite, which veins the metamorphic strata, appears to be principally red, through not always, for at the falls of Gairsuppa it is grey, and sometimes it is red in one part of the vein, and grey in another (Voysey); while at Goontacul, near Gooty, a still younger red granite is seen to vein the older secondary one (Newbold). Captain Jenkins mentions a grey granite at

Ramteek, in the hills NE. of Nagpore, composed chiefly of whitish felspar in very large crystals, which is traversed "three or four times" by granitic veins, the granite becoming finer in structure, and redder, as it is more recent. Red granite, however, is far from being exclusively the colour of the secondary granites, though it seems to be the most prevailing one.

*Protogine, Syenite, Pegmatite.*—The granitic rocks vary in structure and in mineral composition as they do in colour—hence these appellations: at one place they are syenitic, at another protoginic, and at a third pegmatitic, while a very common form is the quaternary compound called *Syenitic Granite*, from its containing hornblende as well as mica. This is the prevailing felspathic rock of the Neilgherries (Benza). Christie was of opinion that white and red syenites were the most prevalent rocks of the peninsula; and that, from being associated with granite, they were the same as those of Egypt. All who have observed the felspathic rocks of India have been struck with the large size and beautiful flesh-colour of the crystals of felspar, and of its frequent prevalence in place of the other ingredients. At Severndroog some of the reddish-coloured crystals are nearly two inches long, and imbedded in a small-grained reddish granite. Some of the dark-red crystals at Roan, in the district of Dharwar, contain minute veins of quartz, and cavities filled with crystals of chlorite (Christie); and occasionally in the Southern Mahratta Country the whole mass consists of red crystalline felspar, granular or in large crystals (Malcolmson, and Mm. Aytoun). Mica appears to be very sparingly disseminated in the large-grained red felspathic rocks, and is frequently replaced by green chlorite, rendering the rock protoginic. Sometimes it is replaced by actinolite (Newbold), and occasionally by epidote. The latter, with red felspar, forms a beautiful rock, in the western extremity of the Vindhya range (Mm. Fulljames); but I am ignorant of its extent. In the Southern Mahratta Country the red felspar is sometimes accompanied by quartz only, which, being transparent and colourless, forms, when coarse-grained, a beautiful pegmatite (Mm. Aytoun). A grey granite prevails at Vencatagherry, which, at Naikencry, at the top of the Moglee pass, contains nests of mica as large as a man's head (Newbold). Sometimes all kinds of granite and granitic rocks may be found in different parts of the same mountain, as in that at Bellary (id.). At Bijanuggur the granite is generally red; at Vingorla, on the Malabar Coast, it is grey.

Tracing these rocks through the tract mentioned, and beginning in the north, we find none in Cutch (Grant); but at Nuggur in Parkur

there is a hill of red and white syenite (id.), which can be traced on in masses just projecting above the sand to Balmeer, and its immediate neighbourhood, where the granitic mountains are 1,200 to 1,500 feet high, and the felspar of an opaque reddish yellow, or flesh-colour, imbedded in a fine-grained syenite (Mm. Forbes). At Jessai, which is a village among this group, the granitic mountains have been deeply fissured by subterranean violence (id.). At Mount Aboo there is granite again (Mm. Waddington); and the Aravulli range consists chiefly of it "reposing on slate," as has before been mentioned (Tod). At Ajmeer and around Jaipore red granite and syenite are seen in veins and dykes traversing the hills and mountains of quartz, which project above the sand in these parts (Jacquemont). Between Oodeypore and Malwa are all the varieties of granite above mentioned, the red and largely crystallized always predominant (Dangerfield). They extend more or less southward to Chotá Oodeypore, near the Nerbudda (Hardy and Dangerfield), and form part of the western extremity of the Vindhya range near Baroda (Mm. Fulljames). The Girnar mountains in Kattyawar consist of a grey syenitic granite (Mm. Aston), and granite mounds are seen projecting above the surface on the site of the ancient Valabipura, a few miles NW. of Gogah, in the same peninsula (Nicholson). Passing to the neighbourhood of the eastern extremity of the Vindhya range, we find the fort of Kallingur, about 110 miles W. of Mirzapore, situated on a hill formed of red syenite capped with sandstone (Jacquemont), and several syenitic mounds in the vicinity. Enormously coarse-grained granite is met with in the Zillah Bahar, as well as fine-grained passing into eurite (Jacquemont and Sherwill); and red syenite near Curruckpore; also in the Bhagulpore and Monghyr districts, on both sides the Ganges, and veining gneiss with trap two miles from Luchmipore (M'Clelland). Returning to about midway between this and the mouth of the Nerbudda, we have granite on the south side of the latter, between Mandela and Amerkuntak (Spilsbury); also syenitic granite with flesh-coloured felspar at Jubbulpore, 30 miles in extent (Franklin); at Baitool, close to the northern border of the great trap district (Finnis); veining limestone, and bursting through the sandstone overlying it at Nagpore (Malcolmson); in Cuttack (Stirling), Orissa, and the Northern Circars, which, with the province of Bahar, are almost unexplored districts, as far as their geology and mineral resources are concerned. Its great extent in the district of Hydrabad has been mentioned. At Vingorla, on the Malabar Coast, it limits the great trappean effusions of Western India; and thence southward, with the other felspathic rocks, forms the grand plutonic

net-work of the peninsula. There is a granitic ridge a mile long and 120 feet high at the Seven Pagodas, between Madras and Pondicherry, close to the sea (Newbold); and at the Amboli pass, about 20 miles from Cape Comorin, the mountainous tract of Southern India ends in a bluff peak of granite, probably about 2,000 feet high, from the base of which a low range of similar rocks extends southward to the sea (Calder). Everywhere the red felspathic granitic rocks are mentioned more than the grey or white felspathic variety; everywhere, almost, the former appear to vein the metamorphic strata, where they exist; and almost everywhere both secondary granitic and metamorphic rocks appear to be again veined or dyked by greenstone (diorite) and the trappean rocks.

*Leptynite, Eurite, and Porphyry.*—The first is occasionally mentioned by Newbold, and *Eurite* not unfrequently; but *Porphyry* very seldom. With the exception of a dyke passing through gneiss at the northern sally-port of the fort of Seringapatam, near to which Tippoo was killed, I know of no other to which prominence is given. This, which has been described by both Benza and Newbold, is said by the former to consist of "well-defined crystals of red felspar, which is occasionally white, imbedded in a paste of compact felspar of the same colour." It also contains "tourmaline in numerous needle-shaped crystals."

## Diallagic Rocks.

Abundant as these rocks are on the South-east Coast of Arabia, where, with serpentine and diorite, they in extent almost represent the trap of India, there is only one place in India where euphotide is clearly mentioned, and that is at Banuswar, in the Mysore, a little west of Bangalore. Newbold, who has described it, states that it differs from the euphotide of other parts, in being a compound of felspar and quartz, with the latter predominating, the diallage varying in colour from olive grey to smaragdite green.

## Hornblendic Rocks.

*Diorite or Greenstone.*—This rock differs from the fine-grained diorites of the trappean effusions, to which we shall come by-and-bye, in being of a coarser structure and entirely crystalline, and not containing the small portion of amorphous or uncrystalline earth, which the latter do, in presenting no vesicular cavities, and no zeolitic minerals, but imbedding, if anything, chiefly talc, mica, or garnets. Besides these differences, it seldom overlies the other rocks to any extent, occurring

chiefly in veins, intercallations, dykes, or mural ridges, the latter sometimes, with granite on each side (Malcolmson).

Its structure, composition, and colour vary: for the most part, perhaps, it is largely granular, crystalline, and of a dark or black green colour, when it is almost wholly composed of hornblende, and therefore closely approaches Brongniart's amphibolite; or of a granitoidal aspect and structure, when it consists of equal quantities of felspar and hornblende; or porphyritic, when it is fine-grained, with one or the other of its ingredients in large crystals.

An "old trap" is said to exist in "the big" and "little Mounts" at Madras, and on the granite of the Seven Pagodas, which is compounded of "felspar, hornblende, and quartz, with a small proportion of mica, pyrope and epidote, which enter it as foreign minerals" (Dr. H. *ap.* Voysey). Newbold also describes a similar rock at Chingleput, 36 miles SSW. of Madras, which is garnitiferous. Amphibolites also exist in the Southern Mahratta Country, which are respectively micaceous and garnitiferous (Mm. Aytoun); and a beautiful diorite, compounded of equal parts of translucent, colourless felspar and dark green, granular hornblende, with chlorite disseminated in the latter. A compact greenstone, foliated, and ringing when struck, is often used for lingums (Dr. H. *ap.* Voysey). Common hornblende of an olive green is found in the Bura-maul, in Noorcull, in primitive trap, with garnets (id.). A porphyritic greenstone is found in conjunction with syenite in a considerable tract between the villages of Curhurbalee and Palmow, in the zillah of Huzareebagh. The porphyritic structure is produced by small pieces of talc, of uniform size, disseminated throughout the mass of hornblende (M'Clelland).

Going to the southern part of the peninsula, Benza describes a tract of 15 miles in extent, 5 miles NW. of Salem, which is composed of diorite veined with magnesite. The structure and composition of the rock is only seen from the surface, as there are no hills, only mounds, which are all interlaced with a net-work of magnesite veins from 0—3 inches in thickness, massive, or in cauliflower crystallization. Stromeyer found this magnesite to be composed of magnesia 47·89, carbonic acid 51·83, and lime 0·28. It is nearly anhydrous, heavy, and so hard and compact as to strike fire with a hammer, breaks with a conchoidal fracture, and has a waxy structure; also effervesces slightly with acids. Asbestus, talc slate, and nephrite occur here and there, and where the magnesite is in contact with the main rock the latter is ophitic. Another part of this diorite probably is alluded to by Newbold, who states that at Karpur, 4 miles NW. of Salem, is a

hornblende schiste, alternating with talcose massive schiste, netted with magnesite veins, along which, also, chromate of iron runs, and layers of magnesian rock like serpentine, the whole of which is dyked with basalt. Chromate of iron is also stated to exist near Trichinopoly, also with magnesite at Hansoor in Mysore (Gilchrist); and the latter in the Nellore district. Serpentine is often mentioned in subordinate beds in mountains or hills, among the hornblende schistes, but never serpentine rock, occurring with diorite and euphotide, as in Arabia. It is, perhaps, worth remembering, that the only part of India where hornblendic rocks, approaching to those of the South-east Coast of Arabia, have been noticed, is in the neighbourhood of calcareous beds belonging to the lower Cretaceous and upper Oolitic systems; and these, again, have only been noticed in the southern part of the peninsula, between Pondicherry and Trichinopoly. May we infer from this, that the latter exist on the coast of Arabia, and that they never have existed in the greater part of India?

Like the granitic, the greenstone rocks vein and dyke the metamorphic strata almost everywhere, and, coming after the former, vein them also, while they are in their turn cut through by the trappean rocks.

As before stated, their greatest continuity is seen in mural ridges, and not as overlying rocks. They occur extensively both in the granitic district of Hydrabad, and throughout the peninsula (Malcolmson and Newbold). Some dykes have been traced for 20 miles continuously (Newbold). About Hybrabad they are from 100 to 300 feet broad, and may be traced from 15 to 20 miles, occasionally spreading out a little (Voysey). About 4 miles south of Dhonee, between Gooty and Kurnool, there is a basaltic greenstone dyke, 150 feet high and 200 feet broad, running through a range of sandstone and limestone mountains (Newbold), and near the village of Bunkapilly, within 4 miles of the Munjira, as well as on the banks of the Munjira itself, Voysey saw a "greenstone or syenitic greenstone" veined with granite, the granitic veins being in some parts red, in others white, and projecting 2 feet beyond the weathered surface of the greenstone. This must not be set down, however, as an instance of granite veining greenstone, for the genuineness of the latter is by no means apparent, from his calling it "greenstone or syenitic greenstone."

The other two rocks mentioned in the table, viz. *Eclogite* and *Hemithrene*, though probably existing, have not yet been mentioned in India. For their characters, as well as for those of the other rocks in

this group, I must refer the reader to the Article "Roches," by Alexandre Brongniart, in the "Dictionnaire des Sciences Naturelles."

## IV.

### "CAMBRIAN AND SILURIAN ROCKS" (M'Clelland).

*Newer Clay Slate, with beds of Quartzoze Breccia.*
*Transition or Cambrian Gneiss.*
*Syenite.*
*Porphyritic Greenstone.*
*Hornblende Slate.*
*Slaty Quartz.*

We have now come to a period which followed the eruption of some of the red felspathic rocks, at least, in which it seems desirable to bear in mind that chlorite frequently replaced the mica, rendering the rock protoginic, and that the crystals of felspar themselves sometimes contained chlorite. Voysey mentions the passage of granite about Hydrabad "from greenstone to pot-stone." Stirling mentions that the granite about Ganjam, in Cuttack, is chiefly red, and abounds in garnets, and veins of steatite. Chlorite slate, steatite, and hornblende, with mica, and abundance of garnets, all form parts of the metamorphic rocks, and we therefore must be prepared to meet their *debris*, together with those of the red felspathic ones which broke through them, in the sedimentary strata which immediately followed the eruption of the latter.

Such a system of stratified deposits appears to exist in the Curruckpore and Rajmahal hills, in the Bhagulpore district, where they have been studied by Dr. M'Clelland, who describes them provisionally, as they have as yet yielded no fossils, under the head of "Cambrian and Silurian Rocks," as follows:—

### "*Newer Clay Slate and Quartzoze Breccia.*"

"The old or primitive variety is succeeded by the newer green or Cambrian variety of slate: the greenish or newer clay slate, referred by authors to the transition or greywacke series, extends from Bhem Bhan to midway between Goordhee and Murgrah, being a distance of 6 to 8 miles in a SW. direction, across the traverse of the strata, which run SE., and dip SW.

"The continuity of the old blue and newer green slates is interrupted by intermediate beds of quartz and talcose slates, which interpose between them.

"*Beds subordinate to the Newer Clay Slate.—(a)* Blue compact quartzoze breccia, veined, like marble, with white streaks, resembling

transition limestone, occurs in beds of 5 to 50 yards in breadth, alternating with the newer clay slate, between Bhem Bhan and Goordhee.

"(*b*) Greywacke, or Steatitic Sandstone.—This greywacke or steatitic sandstone forms the abrupt and precipitous ridge of outer ghats at Guidore, where it is used as a building stone in the construction of the old fort at that place. It is a quartzoze sandstone, containing steatite and diallage which give the fresh rock a peculiar greenish yellow colour, and resinous lustre, with a compact splintery fracture; all which characters it loses on long exposure, becoming an ordinary fine-grained, yellow earthy sandstone.

"It terminates at the north side of the pass by which the Kewlee river enters the plains at Guidore, where it forms a bold precipitous escarpment, resting on mica slate.

"I have been long familiar with the characters of this rock in Kemaon, and although I never saw it covered by any other, yet I believe its proper place to be with those great quartzoze beds which are connected with the newer clay slate, but never on any subsequent formation,—an important practical point to understand, as it places this rock considerably anterior to the sandstone of coal measures, for which it might otherwise be mistaken.

"*Transition or Cambrian Gneiss.*"

"This rock is of great extent in the Bhagulpore district, composing two-thirds of the intermediate country from the Curruckpore to the Rajmahal hills, together with the greater portion of the southern ridges of the Rajmahal group. It consists of quartz, more or less hornblende, lenticular nodules of felspar, more or less compressed and flattened, coarse garnet pebbles, and mica, all embedded in a matrix of earthy, half crystalline felspar. When the hornblende predominates, the rock assumes the form of a soft, pliable hornblende slate.

"These beds sometimes suddenly change into a fine granular structure, retaining all the ingredients of the coarser variety, but assuming the appearance of sandstone flags, (between Mungra and Belbarh).

"From the partial or complete decomposition of the hornblende and felspar, the rock often appears as a coarse pseudo-crystalline conglomerate, containing nodules of felspar. (Bed of the Bundooah river.)

"In other situations the formation assumes the form of slaty quartz, or a somewhat compact, but close granular structure, containing more or less mica and hornblende, chiefly the latter. Beds of this

quartzoze variety alternate sometimes with the coarse-grained rock. (Suyápatam.)

"In some situations the formation passes into, and alternates with, beds of micaceous and hornblendic schistose form, and even contains small beds of calcareous breccia; all which varieties are met with in the ascent from the ghat below Suyapatam, where the formation is much disturbed by outbursts of trap and quartz dykes.

"Thus the line of section from midway between Goordhee and Mungra to Suyapatam, a distance of 12 miles, at right angles to the direction of highly inclined strata, extends exclusively over this formation, the strata running during the first part of the section, with slight deviations in the direction of NW., dip 45° to 60° SW.

"From Nungajoor to Luchmipore, the first part of the country along the same line of section is much disturbed and broken up by quartz dykes and rounded hills of trap. Amidst these disruptions, beds of the same coarse-grained slaty rock reappear at intervals, composing the country as before.

"After passing Luchmipore about a mile, in continuation of the same line of section, the rock is seen passing in places into syenite, with outbursts of which it alternates, more or less, all the way to Noonyhath.

"From this last mentioned place to Kottycoon, a distance of 24 miles along the same line of section, (still crossing the direction of the strata), the rock resumes its characteristic coarse crystalline slaty structure, much resembling gneiss, but distinguished from that rock by the addition of hornblende, which is always present in this, while it is of rare occurrence in primitive gneiss.

"It also differs from the primitive rock in the manner in which it occurs, filling up valleys, and forming low undulating plains between primitive mountains of clay slate and gneiss, as in the intermediate low country between the Curruckpore and the Bhagulpore hills; again (though broken up by eruptions of syenite), between Nangajoor and Noonyhath; and lastly, as it occurs in the somewhat elevated valleys composing the north-western declivities of the Rajmahal hills, extending from Noonyhath to Kottycoon, encircling the base, but never ascending higher on the acclivities of mountains.

"At Kottycoon it is succeeded by beds of granular slaty quartz and trap as before, and finally disappears beneath the conglomerate underlying the coal measures.

"*Mineral Contents of Transition Gneiss.*—Garnets abound in this rock, more particularly in the vicinity of quartz dykes, where they

form a large proportion of its substance, imbedded in earthy felspar and hornblende, from which they are dislodged by the decomposition of the matrix, and thus form a gravelly deposit on the surface of the soil. (Suyapatam.)

"The garnets here are of uniform size, and spheroidal shape, somewhat larger than a musket ball, and when sharply struck with a hammer, each nodule separates into two equal parts, without exhibiting a fractured surface. I observed the same phenomenon many years ago in quartzoze vein-stones, from veins of clay slate in Kemaon. It contains no valuable minerals.

"*Syenite.*"

"This consists of unstratified, erupted masses, composed chiefly of crystalline felspar and hornblende, with a small proportion of quartz. Felspar is the predominant ingredient, and generally gives more or less of a reddish yellow colour to the mass. It forms lofty conical peaks, (Lugwah near Noonyhath), and rounded hills, each sometimes composed of a single unbroken mass; (Panch Pahar, in the Bhagulpore district, and Chara Pahar, in Pergunah Curruedyah, between Palmow and Curhurbalee;) or it is broken into smaller overlying masses, either protruding singly from the surface (near Luchmipore and Suyapatam), or accumulated in rugged pyramidal hills (Nanegore, near Bunta-Rampore, in Pergunah Mellypore, Monghyr district).

"These syenites sometimes pass into the transition gneiss, (2 miles from Luchmipore, on the way to Serieah, and also at the base of Lugwah hill, near Noony,) and are also found in veins, along with trap, penetrating gneiss. (Bed of the Kuttooreah river, 7 miles from Luchmipore.)

"*Mineral Contents of Syenite.*—This syenite contains galena at Panch Pahar, (Sherwill,) as well as at Turee Pahar, and some other places in the Bhagulpore district. In the first mentioned locality the galena occurs in a decomposing bed of coarse granular quartz, glassy actinolite, or, (as Mr. Dodd suggests,) perhaps, coccolite and earthy felspar. The galena, in small crystals, constitutes about 2 per cent. of the mass."

At another part of the same district it is more abundant, and found by Mr. Dodd to be rich in silver.

"*Porphyritic Greenstone.*"

"This first appeared in the bed of the Kuttooreah river, 7 or 8 miles on the NW. side of Luchmipore, in the Bhagulpore district, where it occurs massive, as well as tabular and stratiform, consisting

of hornblende and quartz. It is extremely hard and unyielding. The quartz in the massive variety is distributed into numerous diffused crystalline points, which are dispersed throughout the mass. In the tabular variety the quartz occurs in plates and flattened nodules, disposed in parallel lines with the tabular structure, presenting the appearance of hornblende slate, with which it corresponds in structure, at Soorudjajah.

"In this shape it forms a belt of country 3 or 4 miles in breadth, alternating in places with transition gneiss, both rocks being much dislocated by eruptions of secondary trap, which last occurs abundantly, particularly at Luchmipore.

"*Hornblende Slate.*"

"Beds presenting the appearance of hornblende slate, but containing quartz aggregated in compressed and flat lenticular-shaped nodules and plates, instead of felspar, occur in the Rajmahal hills in the bed of the Goornara river at Kottycoon, where it forms in some localities the basis of the coal measures, and in others it gives support to thick beds of granular slate quartz.

"The same hornblende slate also occurs in the bed of the Brahminy river at Buktahn Pahar, likewise forming the rock on which the coal measures rest. It extends from thence to Curracutta, where its line of junction with the conglomerates underlying coal measures is well shown.

"This hornblende slate marks the boundary of the coal measures for a distance of 20 miles, and forms considerable tracts of the adjacent country, where the coal measures disappear.

"This hornblende slate appears to be identical with the Luchmipore porphyritic greenstone; the only difference is that the quartz is aggregated in lenticular nodules, or compressed into plates, so as to produce a slaty structure, more, however, in appearance than reality, for the rock can scarcely be said to possess a slaty fracture, being very difficultly frangible; so that there is little or no real distinction between it and the Luchmipore rock, except the lenticular or laminated form of the quartz.

"*Slaty Quartz.*"

"This consists of granular quartz, for the most part of thick slaty structure, sometimes thick-bedded, but always more or less disposed to split into thin hard flags. It occurs capping indifferently the subcrystalline and other trappean slaty rocks described in this section. The Dhunya mountain, at Kottycoon, in the Rajmahal hills, is com-

posed entirely of these beds, affording a thickness of at least 400 feet, resting on the transition gneiss, and hornblende slate of this place. It likewise occurs at the Oosilah pass, under similar circumstances, capping the outer range of ghauts below Suyapatam in the Bhagulpore district.

"The lower beds in both these localities assume a massive character, and resinous or waxy lustre, indicating an approach to the steatitic or greywacke quartzoze sandstone of Guidore, to which period they perhaps refer, being anterior to all the coal measure conglomerates, although it is difficult to fix the exact position of these quartzoze sandstones, from the circumstance of their forming isolated mountain caps, uncovered by other rocks. It contains no useful minerals.

"*Conglomerates underlying Coal. (Old Red Sandstone?)*"

"These conglomerates form a hilly tract, extending south from Curracutta, in the Rajmahal district, as far as the country has been examined in that direction.

"The northern boundary of this formation is well marked by the Curracutta hill, a prominent double-peaked mountain, 900 feet above the sea, situated about 5 or 6 miles south-west of Mussinia. About a mile west of the last mentioned village the coal measures insensibly disappear, and all traces of them are lost on a low ridge 2 miles distant, which is the only point in the Rajmahal hills where these coal measures are not bounded by trappean rocks.

"The conglomerates which here displace the coal measures consist of thick-bedded coarse sandstone, composed of gravel, sand, and various sized quartzoze pebbles, embedded in a fine argillacious matrix. These coarse and thick beds alternate with thin-bedded, close-grained, flag-like sandstones, of a fine texture, varying in thickness from 12 to only 2 or 3 inches, succeeded, again, by coarse and thick beds of the same nature.

"After several alternations of this kind for the space of a mile or more (extending across the direction of the strata), the rock assumes a more uniform character and a reddish colour.

"Curracutta mountain consists of a mass of syenite, covered by hornblende slate on the one side, and by the conglomerates under description on the other. The disruptive mass is prolonged on the north side into a large trap dyke, which has been traced for some miles.

"These conglomerates, resting on syenite and hornblende slate,

terminate a few miles north of Curracutta mountain, forming a narrow wedge-shaped tract, dipping to the east, beneath coal measures.

"West and south of Curracutta the conglomerates expand, in the direction of the strata, into broad and lengthened ridges and valleys, extending for several miles to Semanijoor, where they become covered beneath the secondary trap of the district.

"From the general aspect of the country to the south, it is presumed that it is composed chiefly of these conglomerates, extending towards the civil station of Soorey, in which direction, according to information received from that place, coal measures again occur.

"From Curracutta to Semanijoor these conglomerates are undisturbed, presenting an uniform dip of about 20°, for a distance of 5 miles across the outgoing of the strata; but approaching Semaijpoor, the strata there become invaded by, and covered with, outbursts of trap, which compose all the country lying to the north, except where small patches of altered coal measures occur.

"No fossils were found in this formation, the nature of which is therefore inferred merely from its position between the coal-formation on the one hand, and the other trappean and slaty rocks on the other, as well as from its mineral characters, which differ very much from those of coal measure conglomerates.

"*Subordinate Beds.*—No carboniferous shale or clay iron-stone occurs in this conglomerate."

Such are Dr. M'Clelland's descriptions of his "Cambrian and Silurian Rocks," together with his "Old Red Sandstone": we have now to identify these deposits with similar strata in other parts, if possible; but, before attempting this, it is desirable to premise the following tabular summary of their principal characters:—

*Table.*

| | |
|---|---|
| *Old Blue Slate.* | Old Blue Slate, superposed by beds of quartz and talcose Slates. |
| *Newer Clay Slate.* | Newer Clay Slate, alternating with the following subordinate beds:— |
| | Blue compact Quartzoze Breccia, veined, like marble, with white streaks, resembling Transition Limestone; in beds of 5 to 50 yards in thickness, alternating with newer clay slate. |
| | Greywacke or Steatitic Sandstone; consists of a quartzoze sandstone, containing steatite and diallage of a peculiar greenish-yellow colour, resinous lustre, and splintery fracture; alternates with newer clay slate. |
| | Rests on beds of quartz and talcose slates, which again rest on Old Blue Slate. |

| | |
|---|---|
| *Transition Gneiss* | Gneiss in fine and coarse-grained beds, alternating; massive or in flags; composed of quartz, more or less hornblende, lenticular flattened nodules of felspar, coarse garnet pebbles, and mica; imbedded in a matrix of earthy half crystalline felspar; occurs sometimes in the form of sandstone flags, of a granular structure, slaty, quartzy, with more or less mica and hornblende; alternating with coarse beds of the composition above described. It presents micaceous and hornblende schistose beds, and even small beds of calcareous breccia. Rests on primitive gneiss or primitive clay slate, and passes into syenite. |
| *Syenite* | Syenite, chiefly composed of crystalline, reddish-yellow felspar and hornblende, with a little quartz, the felspar predominating. Passes into "Transition Gneiss"; veins gneiss along with trap. |
| *Porphyritic Greenstone* | Greenstone of a porphyritic structure, stratiform or massive, consisting of hornblende and quartz; quartz disseminated in numerous crystalline points in the massive variety; in flattened nodules, as above stated, in the stratiform variety. Alternates with strata of "Transition Gneiss." |
| *Hornblende Slate* | Hornblende Slate of a porphyritic structure, consisting of lenticular compressed nodules, and plates of quartz and hornblende. Underlying either the basis of cold measures, slaty quartz, or "Old Red Sandstone" conglomerate. |
| *Slaty Quartz* | Granular Quartz of a thick slaty structure, becoming massive below, and of a resinous or waxy lustre (indicating an approach to the steatitic or greywacke quartzoze sandstone of Guidore). Capping the sub-crystalline and other trappean slaty rocks of this section; thickness 400 feet. |
| *Old Red Sandstone* | Conglomerates in thick beds, consisting of gravel, sand, and quartz pebbles, in an argillaceous matrix, alternating with thin beds of fine-grained sandstone, flag-like; assuming, after a mile across the direction of the strata, a more uniform character, and reddish colour. Position, between the coal measures and older trappean and slaty rocks. |

Such is a tabular view of these strata; and looking for their extension to other parts, we cannot help being struck with the great resemblance that exists between the composition of the "Greywacke or Steatitic Sandstone" and "*Transition Gneiss*" of the Curruckpore and Rajmahal hills, and the steatitic sandstone which immediately overlies the syenitic and greenstone hills of Kalinghur and Adjighur, so minutely described by Jacquemont. With his "porphyritic stratum" which traverses this sandstone, we have nothing to do just now; but he particularly alludes to the *steatite*, which divides the strata of sandstone into layers, and enters into the arenaceous structure of the rock

in parallel laminæ ; the *red felspar*, in portions of a laminated structure ; and rounded portions of quartz, with mica ; presenting here and there spots of a violet colour.

Moreover, as regards the origin of these materials, Jacquemont, in describing the syenite below them, notices varieties in which " mica s'associent à l'Amphibole, sans jamais la supprimer entièrement ; des roches de Felspath et d'Actinote, ou de Felspath et de Diallage douteuses, ici comme à Adjighur dans la nature de leurs elements" (Tom. i. p. 431).

We therefore may, I think, reasonably infer that the sandstone of these localities, and the " Greywacke or Steatitic Sandstone" and "*Transition Gneiss*" of the Bhagulpore district, were chiefly derived from the red felspathic rocks, and that too, probably, of the same age, even if we doubt the identity of the formations. As to the presence of " garnet pebbles" in the " Transition Gneiss," that may depend on locality ; as well as the eruption of syenitic and greenstone rocks. The "*Slaty Quartz*" rock, Dr. M'Clelland thinks, is allied in composition to his " Greywacke or Steatitic Sandstone."

Passing to the other side of India, viz. to the Southern Mahratta Country, we have here too, in the neighbourhood of Dharwar and elsewhere, a conglomerate, similar to the " Greywacke, or Steatitic Sandstone." Lieutenant Aytoun also gives a section of a hill about 3 miles south of Bhagulkote, which is composed of sandstone and schistose clay, alternating in very thick beds. In the valley between Yarkul and Bhagulkote, crystalline greenstone and green schistes alternate with each other in strata which are nearly vertical, and on each side of them are ranges of vertical strata of sandstone, consisting of jaspideous and quartz pebbles, with much felspar, in a sandstone cement (Aytoun) ; also in the bed of a watercourse at Kaludghee, Christie observed slates interlaminating with greywacke. Newbold also states that the sandstone overlying the granite between Gooty and Kurnool, which at the former place is red, and contains chlorite and actinolite mixed with the felspar, is composed of " white quartz pebbles, from the size of a filbert to that of a man's head," a few of trap and hornblende, and of tough actinolitic felspar, also flinty slate, the very hardest parts of the hypogene and granitic rocks ; but he saw no fragment of ordinary granite, or of gneiss. Going to the north, there is a decomposing conglomerate at Balmeer of the same description, the greatest part of the cement of which, as well as parts of the pebbles themselves, is composed of a chalk-white, fine, steatitic earth (Mm. Forbes). Of the existence of a green steatitic sandstone or greywacke in the Southern Mahratta

Country, composed of greenish chlorite, red felspar, and quartz pebbles, there can be no doubt; and with reference to the presence also of "Transition Gneiss" there, Christie observes: "All the transition gneiss I have seen in Dharwar is weathered, closely resembling loose sandstone." The only "primitive gneiss" he appears to have met with was at the falls of Gairsuppa.

The same remarks, however, apply to the identification of these deposits with those of M'Clelland's "Cambrian and Silurian Rocks" of Bhagulpore, that I made with reference to the confusion which exists between the Older Metamorphic Strata and the metamorphosed strata of newer formations. There is comparatively nothing definitely described respecting any of them, and it is evident that there are not only the Metamorphic Strata, and the "Cambrian and Silurian Rocks," provisionally so called, but also metamorphic rocks of the following group; all of which are at present so uncharacterised, that there is no possibility of finding out to which series the observations on such rocks apply. The slates of the Older Metamorphic Rocks appear to be most extensive; the deposits of the "Cambrian and Silurian" follow; and those of the next series the least by far, of all. Further than this we hardly know more than that such series exist.

Our last step is to identify the "*Old Red Sandstone*" of M'Clelland, but this cannot be well done until the following series is described, which we shall provisionally call "Oolitic."

V.

OOLITIC SERIES.

Tara Sandstone.

Kattra Shales.... { *Shales.* *Limestone.* *Coal.*

Punna Sandstone.

Previous to entering upon a separate description of the members of this series, which has already been stated to be the most interesting in India, on account of its almost universal occurrence, its mineral resources, and its organic remains, it will be as well to premise a few observations on the facts which have led to a knowledge of its existence, and of the parts into which it has been subdivided.

That tract of it which is most continuous, and appears to have been least disturbed by volcanic influence, extends from the eastern border of the trap of Malwa, near Saugor, to the alluvial deposit of the Ganges near Mirzapore; and it is therefore to this that we must chiefly look for its typical characters.

Captain Franklin, who first explored this district, pointed out, that in travelling SW. from Mirzapore into Bundelkhund, two ranges of hills or escarpments are successively ascended, each of which terminates in a plateau. The first range is entirely composed of sandstone, presenting no argillaceous strata whatever in its composition; but the second range, which rises from the plateau of the first, and is also of sandstone, does present argillaceous strata, viz. in its upper part, which again pass into limestone on the plateau.

Jacquemont, who followed Franklin, apparently with the description of the latter in his hand, recognised a third range of sandstone hills in Franklin's Punna range, which the latter appears to have regarded as merely an accidental elevation of the second plateau; and on ascending these, he observed that they were composed of fine-grained, reddish, and mottled or variegated sandstone, resting on the argillaceous strata, which accompanied the limestone of the second plateau. This range Jacquemont considered about 300 feet high.

Moreover, in a well from 36 to 45 feet deep, between Douzounepore and Puttrahut, he found small layers of anthracite between strata of compact limestone, the latter breaking with a conchoidal fracture, and presenting a dark, black-blue colour. These are his words:—"Le carbone, en quelques places, s'y resemble assez pour former de petites couches minces, qui ont tout-à-fait l'aspect brillant et la dureté d'Anthracite."

Lastly, Dr. Adam, who travelled across these sandstone ranges, states that at Lohargong the limestone is in a valley bounded on all sides by sandstone hills, which valley he compares to the bed of a lake, into which the Ken river enters on the south, and makes its exit at the northern border; and on leaving this valley to proceed southwards to Bellary, which is 45 miles distant, he passed over a ridge of sandstone hills. This fact, if it were necessary, might be adduced to support Jacquemont's observation, that there is a sandstone formation above the shales and limestone. Both Franklin and Adam allow that the limestone rests on the sandstone of the second plateau but, *they* go no further.

Let us now turn to a section afforded by the same tract of sandstone in the neighbourhood of Bidjighur, which is about 155 miles east of Lohargong, on the river Son, where the strata dip to the north, as in Bundelkhund, and present a scarped surface towards the south, which is but a continuation of that at Bellary; where, also, I might have mentioned that Dr. Adam, after he had descended the ridge between this place and Lohargong, again saw among quartz rocks (altered

sandstone?) in vertical strata, some, which had "a peculiar striped arrangement in the mass, and in colour, lustre, and compactness, not unlike the limestone of Lohargong." But to return to our subject. Mr. Osborne, who, upon the information communicated by Mr. Heydey, respecting the existence of coal near Bidjighur, was sent to examine that neighbourhood, states, that in going from Bidjighur to the river Son, by the Ek-Poway Ghaut, he saw limestone strata of all colours, and some of a lithographic structure, of which he sent specimens to Calcutta. Afterwards, he picked up black portions of limestone, which is better seen *in situ* in a nulla near Markoonda; and in the bed of the Son, pieces of coal; but he did not see any coal-strata there. One of his sections of the Son shows "limestone" cropping out under 500 feet of "quartzy sandstone," and below the limestone "greywacke." Altogether the following section, from above downwards, is computed from his observations:—

Sandstone, 60 to 80, and 700 feet; shale, with exudations of petroleum; sandstone interlaminated with shale; flinty slate; sulphate of iron; limestone of all colours, some lithographic in structure.

This gives 700 feet of sandstone above the shales and limestone, and when we follow the banks of the Son onwards to Rhotasghur, in the zillah of Shahadabad, we find it still thicker. Captain Sherwill, who surveyed this zillah, writes:—"One of the precipices in the fort of Rhotas I found by measurement to be 1,300 feet, a sheer mass of sandstone, without a bush or tree on its surface." And afterwards, in alluding to the limestone on the eastern scarp of this sandstone table-land, he states, that it forms "an unbroken bed from the foot of the fortress of Rhotas to the village of Dowdand, a distance of 30 miles north"; and, still "proceeding in a north-westerly direction, at the distance of 13 miles, we meet with the same limestone in the valley of Soogrea-Khoh, at the depth of 1,000 feet below the summit of the table-land." The general appearance of this limestone is of a dark slate colour, breaks with a conchoidal fracture, strikes fire with steel, is impalpable in texture, and quite free from any exuviæ. Portions of it were sent to Calcutta for trial in lithography. In a few cases it was nearly black, also of a pale yellow or buff colour.

Under the fortress of Rhotas, and in other places, Captain Sherwill also states is the following section:—"Sandstone 1,000 feet; indurated pot-stone 30 feet; dark schistose rock or ore of alum, 10 or 12 feet."

There is this important distinction, then, between the sandstone of the ghauts or escarpments which lead to the table-land of Bundelkhund

near Mirzapore, and the escarpment of the sandstone at Rhotasghur, viz. that one has the shales at the top, and the other has them at the bottom.

Passing still further eastward, and leaving the valley of the Son, together with the great continuous sandstone tract of Bundelkhund, we, according to Captain Sherwill, first meet, in the zillah of Bahar, with granite hills capped with sandstone; then at Gya others which are completely denuded; and on arriving at the boundary of the zillah of Monghyr, granite peaks, projecting from amidst hills of quartz.

We have now reached that point on the Ganges, about 60 miles south of which, that is from Soorajghurrah, is the Curhurbalee coal-field, which rests on M'Clelland's "Old Red Sandstone," and forms one of the great coal deposits in this part of India; and although we are not, in the present state of our knowledge, able to connect it with the carboniferous shales of Bundelkhund, through Bahar, yet the latter may be traced from the banks of the Son to those of the Koyle at Palamow, which, again, is close to the western extremity of the Damoodah valley, where the greatest number of these coal deposits have been discovered, and not far from which, too, is the coal-field of Curhurbalee.

Thus the type of the Oolitic Series above tabled would appear to be established.

That keen, talented, and intelligent traveller Jacquemont,—who knew at once for what to seek, had the ability to discern, and was never at a loss to describe,—during his short visit to Bundelkhund, on his way from Calcutta to Delhi, first completed this series. Franklin, a brother of the great Arctic voyager, had gone so far as to show that the shales and limestone overlaid the sandstone, but Jacquemont added the Punna range of hills to the latter in 1830. Subsequently Malcolmson, in 1837, showed that sandstone overlaid shales and limestone in Southern India, and lastly, Newbold proved, by the following section of the Moodalaity pass, near Kurnool, from above downwards, that the lower sandstone also existed there:—

*Section of the Pass of Moodalaity* (Newbold).

Compact light-coloured sandstone, passing into quartz rock and conglomerate, 120 feet.

Beds of compact limestone, of light tints of green, red, and buff, often lined with dark red jasper, and light-coloured cherts, 310 feet.

Calcareous and argillaceous shales, usually reddish, and liver-coloured, passing into white; surfaces of laminæ often covered with light green (chloritic?) flakes, 50 feet.

Laminar sandstone, micaceous scales between the layers.

Massive sandstone.

Previous, however, to all these, Captain J. D. Herbert (1828) stated, respecting some coal which was found by Lieutenant (now Colonel) Cautley, in the vicinity of Nahn, about 40 miles ENE. of Umbala, in the Sub-Himalayan range, that it exists in a formation of fine sandstone above, shales and limestone in the centre, and conglomerates below; that this is the "Coal Rock" of India; and he further adds: "This sandstone is, I think it almost certain, part of an extensive secondary formation, which on the one hand includes the sandstone hills of Sylhet, and on the other the saltiferous range of Lahore."

Lastly, in 1837 Captain (now Colonel) Grant's valuable paper on the geology of Cutch appeared, and in it also may be traced a similar series to that of Bundelkhund, as the following section, from above downwards, compiled from his descriptions, will show.

Sandstone, coarse and soft, or compact and crystalline.
Slate-clay of vast thickness, alternating with limestone of a lithographic structure, and grey colour, also occasionally with slaty sandstone.
Thin beds of coal intermixed with blue clay or shale, thick beds of sandstone alternating with slate clay.

Having thus endeavoured to show the general distribution of the series above established, let us now proceed to the description of its members separately.

## Tara Sandstone. (H. J. C.)

This name is derived from the Tara Pass or ghaut, which leads from the alluvial deposit of the Ganges, about 10 miles SW. of Mirzapore, to the summit of the first sandstone range of Bundelkhund, the route taken by Franklin and Jacquemont, who have described it.

*Synonyms.*—New Red Sandstone (Franklin and Jacquemont). Old Red Sandstone ? (M'Clelland).

From Franklin and Jacquemont we learn that the Tara Sandstone is composed of fine grains of quartz, with a little mica, which is held together by an argillaceous cement of a red colour, the latter varying in intensity. Its structure is "rather friable than compact," but in many places is sufficiently hard for architectural purposes. It is horizontally stratified, but presents nothing else, except a few nests of red clay here and there, to disturb its uniformity and continuity.

Towards its upper part the grains become extremely fine, and the colour of the mass changes to green; after which it passes into argillaceous (and talcose ? Jacquemont) strata of green and red colours alternating, but the latter still continues to predominate.

The thickness of this deposit has not been stated. It could not be determined at the Tara Pass, on account of the base of the hills being under the alluvial deposit of the Ganges. But Jacquemont remarks, on the authority of Captain Drummond, that the summit of the Tara Ghaut is 300 metres (900 feet in round numbers) above the valley of this river.

No fossils have been found in this sandstone, and no minerals, beyond the red oxide of iron which colours it.

At the pass of Moodalaity mentioned, Newbold describes this, or the lower sandstone there, as "laminar" and "micaceous," passing downwards into "massive sandstone," and above into shales of white and red colours, with green flakes of chlorite.

In Cutch the Tara Sandstone is not noticed by Grant, probably from the insufficient elevation of the masses; and his boring experiment appears to have only reached its upper part, if even that.

*Identification with* "Old Red Sandstone" *of M'Clelland.*—This consists in the great simplicity of composition in both; the absence of crystals of red felspar, which may be inferred from the silence of Jacquemont and M'Clelland on this point, and the situation of this formation immediately below shales and carboniferous deposits in both instances, which are evidently connected with each other. The presence of conglomerates at the Tara Pass is not seen, perhaps because they may be underneath the alluvial deposit of the Ganges; but the texture of the sandstone is stated by Jacquemont to become finer in ascending, and therefore probably becomes coarser in the opposite direction.

With reference to the lower limit of this sandstone, Jacquemont, in alluding to the difference between it and that of Bundelkhund reposing on the syenite of Bisramgundj Ghaut and Adjighur, close by, states:—"Malgré l'extrême ressemblance oryctognostique dont je viens de parler, j'incline à croire cependant, que les grès du Tara Ghaut et du Kuthra Ghaut appartiennent à une autre formation, et que cette formation est celle du *New Red Sandstone*; mais je soupçonne que le grès rouge ancien recouvre les Syenites du Bisramgandj Ghaut et de toute cette partie des montagnes de Bundelkhund."

He also states that he did not see the junction of the two, but that this might have been concealed by superficial detritus; while Coulthard observes of the sandstone at the opposite extremity of Bundelkhund, near Hirapur, between Saugor and Punna, that the granite is "capped by heaps of ferruginous conglomerate, which

conglomerate is connected with a stratum of iron ore, on which the 'New Red Sandstone' is seen to repose" : this sandstone, again, becomes covered with red and variegated shales in approaching Saugor, followed by the superposition of more sandstone, which here and there, as in a hill at Bhilsa, presents the flat top and scarped sides, which we shall by-and-bye find to be characteristic features of the upper member of this series.

Should this identification of the sandstone of the Tara Ghaut and the "Old Red Sandstone" of M'Clelland be correct, I would adopt the term of "Tara Sandstone" for both, particularly as the latter is provisional.

Kattra Shales. (H. J. C.).. { *Shales.* *Limestone.* *Coal.*

This term has been taken from the Kattra Ghaut, which is the name of the pass leading from the first to the second plateau of Bundelkhund, where Franklin and Jacquemont saw respectively the Tara Sandstone passing into argillaceous strata; limestone on the second plateau; bituminous shale cropping out in the glens of the Bajin river; and anthracite in a well; so that representatives of all three sub-divisions of this member of our Oolitic Series are thus found to exist in Bundelkhund, though more developed elsewhere.

*Synonyms.*—Clay-Slate Formation (Voysey). Argillaceous Limestone (Malcolmson). Laminated Series or Upper Secondary ? (Grant).

*Shales.*

These in their purest state are almost entirely composed of indurated clay, and arranged in strata of all degrees of thickness, varying from laminar to massive, and of all kinds of colours. When mixed with other substances in company with them, which is frequently the case, they may be calcareous, bituminous, quartziferous, micaceous, talcose, or chloritic. They pass into the sandstone both above and below them, and alternate with it in some places, to such an extent that "the cascade of the Ranj river," in Bundelkhund, according to Franklin, "shows a series of sandstone interstratified with slate clay, 390 feet thick." They are also interstratified with limestone and coal, either together or separately, and though sometimes almost deficient in both, they chiefly derive their importance from the presence of one or the other of these deposits. There is, therefore, little to be said about these shales by themselves, and their geographical extension will be best considered in connection with the other members of the series.

Respecting their fossiliferous contents, too, *per se*, there is little known. Dr. Bradley, in a letter on the sandstone at the northern border of the trap, writes:—"In the shales north of Ellichpoor was the only place where I found impressions of leaves, plants, and ferns. The ferns appear to belong to *Pecopteris*. In one, however, the pinnules differ. Stems, leaves, reeds, and matted leaves abound." But it is in connection with the coal strata, or overlying sandstone of this series, that the fossils of the shales have been chiefly found, and it is therefore with the descriptions of these that they will respectively, be noticed.

*Limestone.*

The principal characters of the limestone are its uniform lithographic texture, solidity, conchoidal smooth fracture, and hardness; dendritic surfaces; smoky grey colour, passing into dark smoky blue; and parallel thin stratification.

Everywhere it presents these characters: in Cutch, near Neemuch, Bundelkhund, on the river Son, near Bidjigurh and at Rhotasghur, Firozabad on the Bhima, Kaludghee in the Southern Mahratta Country, on the middle third of the Kistnah, and as far south as Cuddapah, in the Madras Presidency. Grant, Dangerfield, Hardie, Franklin, Jacquemont, Sherwill, Osborne, Meadows Taylor (P.MS.), Malcolmson, Voysey and Newbold, have respectively described this limestone in different parts of India, and all agree in giving it the characters above mentioned, while the Society's museum verifies most of their accounts by specimens of this formation from several of these places.

It differs, however, when departing from its genuine composition, just as the shales differ which interlaminate it, the coal strata, and the sandstone, in being more or less argillaceous, bituminous, or quartziferous; of different degrees of hardness, coarseness, and friability of structure; and of all kinds of colours, streaked and variegated; but I am inclined to think that the latter only occurs where it has been exposed to heat. It is sometimes quite black. Lucullite occurs in it between Dachapilly and the Kistnah (Voysey), near Bidjighur on the Son (Osborne), and in several other places.

It is occasionally veined and interlined with jasper and light coloured cherts, which projecting from it under weathering near Cuddapah, give it a scabrous appearance (Newbold); also contains drusy cavities, calcedonies, and cornelian, north of Nagpore (Malcolmson). Small crystals of quartz occur in the lithographic forms, which render them more or less unfit for lithographic purposes; indeed the presence of siliceous matter generally, more than the want of uniformity of structure,

seems to render this limestone too hard for lithography; but I question, among its infinite varieties, whether there is not some place which would yield forms as serviceable as those imported from Europe. The argillaceous varieties are frequently flaked with green chlorite; steatite of a white chalky nature is found in thin beds in it, in the Keymor range (Sherwill), and in the neighbourhood of Cuddapah, where it also passes into the compact form of "French Chalk," and is cut into pencils, which are used for smoothing lime-plaster, and writing on cloth prepared for the purpose (Newbold). A small detached hill at the fort of Rhotasghur is almost entirely composed of a dark blue pot-stone, which, with the small veins and beds of serpentine that are found in low hills in the zillah of Bahar (Sherwill), are not improbably associated with this limestone.

It is of a snow-white colour, and traversed by chlorite schiste in the bed of the Nerbudda between Lamaita and Bëraguth, near Jubbulpore (Franklin); and beautifully granular and crystalline, with red and white steatite intermixed at Khorari, 6 miles north of Sitabaldi, near Nagpore (Jenkins). It also exists in many places in the form of granular, saccharoid, white marble; but in all these instances appears to be metamorphosed by heat. Jacquemont mentions, at Alwar, about 65 miles north-east of Jaipore, thin beds of amphibolic limestone (Hemithrene Bgt.) of a black colour, alternating with quartz in vertical strata, the latter becoming subordinate; and at Bessona (the first town in the territory of Jaipore coming from Alwar) a granular, white saccharoid marble, in some of which green amphibole and flakes of amphibole and talc are also disseminated; also at Rajghur, 7 miles west of Nusseerabad, where mica is added to the amphibole. Thus we have all the chief minerals of the mica and hornblende families in, and in connection with it, but this, as I have before stated, is under a metamorphosed state.

Wherever this limestone is situated throughout India, it has undergone more or less disturbance and denudation. Greenstone and trap appear to be the principal agents which have been engaged in the former, for these almost always accompany it, and are almost the only igneous rocks which appear to have invaded it. Yet it frequently rests on granite, by which it appears to have been upset more than penetrated, and in the Southern Mahratta Country the older metamorphic schistes have been forced up through it; but the only instance recorded of its being veined and enveloped in granite is at Kamari, near Ramteek, in the hills NE. of Nagpore (Jenkins and Malcolmson).

It is not unfrequently brecciated to a great extent, by fracture and

reconsolidation under a cement of calcspar. A remarkable instance of this exists near the village of Guddunkeeree, in the Southern Mahratta Country, where the dyke, so to speak, or edges of the strata brecciated, run along the plain NE. by N. and SW. by S. Lieutenant Aytoun, who describes it, states that it is composed on one side of rhombohedral calcspar, and on the other of breccia. On the WNW. "not less than 20 yards" of pure calcspar exist in contact with the unaltered limestone of that side; and on the ESE. side the unaltered rock gradually becomes more and more brecciated, until it passes into the calcspar. The strata are of course vertical, and the calcspar would appear to have been crystallized from a watery solution.

This limestone is frequently denuded of its overlying sandstone and shales in Southern India, and in this state is not uncommonly covered by trap, as near Ferozabad on the Bhima (Meadows Taylor, P.MS.).

Newbold gives this limestone a thickness of 310 feet at the pass of Moodalaity, near Kurnool; Meadows Taylor from 10 to 30 feet on the Bhima, with strata from 2 inches to 2 feet thick (P.MS.). Dr. Bradley mentions a sandstone hill north of Ellichpore capped with 6 feet of limestone (P.MS.). The Gupta caves of Bahar, about 40 or 50 miles NW. of Rhotas, are in limestone, and their entrance is stated to be from 10 to 12 feet high (Sherwill). Much more definite information, however, on this head, is required, to give an idea of its general thickness; which, probably, its interstratification with the shales, or its position generally, where exposed to view, may have rendered difficult to obtain. In no part mentioned does it appear to be so thick as at the pass of Moodalaity.

*Geographical Extension.*—If we allow the white crystalline marble generally of India to be metamorphic strata of this limestone, which I think we must do, until otherwise proven, then we should have this form of it in the Girnar of Kattyawar; the lithographic or original form, in Cutch; the white marble, about Oodeypore; the lithographic form, between Neemuch and Chittore; the white marble northwards, in the neighbourhood of Nusseerabad, Jaipore, Bessona, and Alwar; that of Mokrano in the Jodpore district, from which the white marble of the Taj Mahal was chiefly taken; a narrow strip in its original state 150 miles long in Bundelkhund; more again about Bidjighur and Rotasghur on the Son; in the state of white marble, in the bed of the Nerbudda near Jubbulpore; also the same at Ramteek, in the hills NE. of Nagpore; along the lower parts of the Wurda and Pyne Gunga towards their confluence, where they form the Pranheeta; thence to the Godavery, and along the latter and its neighbourhood, more or less, to the vicinity

of Rajamundry; in the district of Shorapore, on the Bhima; of every variety of colour, and greatly disturbed and broken up about Kaludgee, in the Southern Mahratta Country; along the Kistnah, from Kurnool to Amarawattee, and more or less all over the triangular area formed by the latter place in the east, Gooty in the west, and the Trepatty hills in the south; south-east of the latter place a narrow valley extends through it for 150 miles, where its strata are in many places vertical (Malcolmson). As yet it has not been noticed in the southern part of the peninsula, either in its original or metamorphosed state, any more than the sandstones and shales which accompany it; at the same time its absence there is by no means determined, for there is metamorphic limestone in the district of Tinnevelly, as has before been stated, which closely resembles that from the neighbourhood of Nagpore; but then all metamorphic limestones are so much alike, that, without more information than their mere locality, they only indicate places which may deserve further examination.

*Minerals.*—Galena in several places in the Cuddapah beds (Newbold); and Dr. H. in Voysey's journal, just after mentioning the limestone, states, that in a branch of hills south of Cuddapah, which runs east and west, he found "small veins of plumbago." This would be interesting if found in the limestone, since, as before stated, this mineral occurs in the metamorphic limestone of Tinnevelly and Ceylon (Major General Cullen).

*Organic Remains.*—Captain Franklin states, that at Nagound (Bundelkhund), in the bed of the Omeron river, where the lower and central beds of the limestone are exposed, "fragments of fossil wood and fragments of stems of ferns" are seen in them. He also gives a figure of a "gryphite shell," which, however, is too indistinct to be of any use; yet he partly upon this founds his opinion of the identification of this limestone with the Lias.

There is a cast of a large turbinated shell, like that of *turbo* or *pleurotomaria*, in the Society's museum, which was found by Captain Nicolls, who presented it, 10 miles NE. of Saugor. It is composed of calcspar. This is close upon the limestone of Bundelkhund.

Writing of this limestone near Neemuch, Dr. Hardie states that the organic remains in it are numerous, and then adds that one kind, when half exposed in the rock, appears in the form of a succession of cylindrical convex bodies, the length of which varies from 1 to 2 inches; they taper to a point, and frequently seem minutely ramified at both extremities. In one or two instances he observed the termination of such bodies to be in the mass itself, and in such cases they had

obviously been arranged in bundles or fasciculi. In other instances these cylindrical bodies appeared to send off anastomosing branches, which unite them together. They do not differ in composition or colour from the limestone in which they are found. He also mentions "longish tapering canals," and another fossil body, shaped like a pear bent upon itself; one of his figured fossils very much resembles the impression of a *Zamites*.

Newbold also mentions tubular and elliptical cavities in the limestone near Kurnool, and near Cuddapah, microscopic bodies of a spheroidal shape and multilocular structure, in the chert, which is imbedded in the limestone.

In the Shorapore district its upper surface in many parts presents a number of conical cavities from 0 to an inch deep, and about half an inch wide at the orifice; they are sometimes so close together as to form a honeycomb appearance, and some seem to have a spiral form, which is indicative of their having been fretted out by grains of sand agitated by the wind (Mm. Meadows Taylor).

Little or nothing fossil, then, has yet been found in this limestone, to determine its age or position geologically in India; and even in Cutch, where so many organic remains exist in the shales accompanying it, no fossiliferous peculiarity has been assigned to it; nor can we expect to find many in it, for in its purest form it appears to be always subordinate to the shales, and then possesses a compact, fine, lithographic texture, which is seldom, I think, accompanied by many organic remains.

The absence of fossils in this limestone, however, is of little consequence, since in the shales with which it is interlaminated, abundance both of marine and fresh-water have now been found; the former sufficient in number and species to enable geologists to place the shales of Cutch among the lower Oolitic deposits. And from the correspondence of the latter together with the Cutch sandstone, in mineral detail, relative position, and physical features, with the shales and upper sandstone of India generally; as well as the proximity if not continuity of these formations in the two countries, I have placed them all provisionally in this series.

The fossils from the shales in Cutch, which are figured in Colonel Grant's geology of that province, consist of impressions of plants and shells:—Lycopodites, ferns, reeds, zamites. Conchifera, terebratula, ostrea, pholadomya. Ammonites, belemnites, and a portion of the bone of a Saurian reptile. The following are Mr. J. de C. Sowerby's

descriptions of the shells; those of the vegetable impressions will be given at the end of the next section :—

N. B.—All the fossils which have not their localities mentioned were found at Charee, about 30 miles NE. of Bhooj, close to the borders of the Runn.

" *Pholadomya ? inornata.*—Transversely elongate, ovate, gibbose, concentrically corrugated; beaks very near the anterior extremity; longitudinal ribs very obscure, rounded. Width 1½ inch, length nearly 11 lines.

" *Pholadomya granosa.*—Ovate, subtriangular, gibbose, ornamented with four or five rows of transversely-elongated and but slightly-elevated tubercles; the anterior side nearly straight, flattened, the posterior produced; beaks very prominent. Length 2 inches, width the same.

" *Pholadomya angulata.*—Subtrigonal, gibbose, ornamented with four or five sharp ribs, which are most prominent near the edge; anterior side straight, nearly flat, length and width equal; in some specimens 2 inches.

" *P. angulata* approaches *P. Murchisoni* var. of Phillips. (Geol. of Yorks., pl. vii. fig. 9.)

" *Amphidesma? ovale.*—Transversely elongate, ovate, convex, slightly wrinkled, anterior side small, truncated; distinguished from the rest of the shell by a gentle depression; posterior extremity rounded, rather pointed. Length 11 lines, width 1 inch 4 lines.

" There is no proof whatever that either this or the following belong to the genus *Amphidesma;* they are, however, very nearly related to a *A. donaciforme* and *A. securiforme* of Phillips.

" *Amphidesma ? hians.* Transversely elongated, convex, slightly wrinkled; sides gaping, the anterior small; separated from the rest of the shell by an obscure depression; the posterior rounded, a little flattened. Length 1 inch, width more than 1¾ inch. The specimen being broken, we have not the measure complete.

" *Corbula lyrata.*—Rounded, triangular, convex, transversely ribbed: ribs about 15, prominent, rounded; posterior side of the larger valve formed into a distinct lobe, convex, nearly smooth; the beak of the same valve much incurved, the margin toothed. Length and breadth nearly equal, sometimes exceeding half an inch.

" Occurs grouped in dense masses with *Trigonia Pullus*, a smooth *Uncula*, &c.

" *Astarte unilateralis.*—Transversely obovate, anteriorly truncated, convex rather flattened, and marked with 8 or 9 concentric rugæ near the beaks; anterior side at right angles with the hinge lines; lunette concave, ovate, pointed. Width greater than the length, but variable in proportion, generally about 1½ inch.

" *Astarte pisiformis.*—Nearly globose, with pointed beaks; marked with 8 or 9 sharp transverse ridges; edge toothed. Length 3 lines.

" *Trigonia costata, var.*—This shell varies slightly, both in form and markings; generally the form is between that of *T. costata* Parkinson, or M. C. t. 85, and *T. elongata*, of M. C. t. 431; which Lamarck, apparently with justice, considers to be but one species.

" *Trigonia pullus?* (M. C. t. 508, f. 2, 3.)—The markings on the posterior side are not so regular as in the English specimens, but there is no other difference.

" *Cucullæa virgata.*—Transversely elongato-quadrate, with projecting incurved beaks, very convex, marked with many longitudinal, irregular, sharp ribs; posterior margin obliquely truncated. Length 1½ inch, width 2¼ inches.

" Loc. between Hubbye and Joorun.

" *Nucula tenuistrata.*—Obliquely oval, finely striated concentrically; beaks close to the anterior extremity. Length 4 lines, width 5 lines.

" Specimens very imperfect, along with *Cucullæa virgata.*

" Loc. between Hubbye and Jooria.

" *Nucula? cuneiformis.*—Transversely elongate, elliptical, gibbose, smooth; beaks close to the anterior extremity, small, incurved. Length 6 lines, width 10 lines.

" *Pecten partitus.*—Broad, short, elliptical, depressed, marked with two concave radii, which divide the surface into three parts, both externally and internally, the lateral parts being flattened; concentrically and minutely waved, waves alternately larger and smaller; ears small, nearly equal. Length 6 lines, width 5 lines.

" Loc. Hubbye hills.

" *Plicatula pectinoides.* (M.C. t. 409.)—If this differ at all from the British species, it is in having rather more the habit of an *Ostrea*, which is apparent in the expansion of the edge.

" *Exogyra conica.* (M.C. t. 26 and 605).—The few specimens most detached from the matrix appear not to be quite so deep as those figured in the 'Mineral Conchology.'

" Loc. Katrore hills.

" *Ostrea carinata?* (Lam. Hist. Nat. vi. 216; M. C. 365.)—The specimens being generally much concealed in the stone, or broken, the determination of the species is not possible; the most perfect individuals resemble the young state of *O. carinata*, but that species is so near in some slates to *O. gregaria*, (M.C. t. 3), and *O. solitaria* (M.C. t. 468), that fragments cannot be distinguished.

" *Ostrea Marshii.* (M.C. t. 48.)—The *O. Marshii* varies so much in different localities, that we find no difficulty in referring this shell to that species, although the plaits are more numerous than usual.

" This specimen is accompanied with an imperfect *Plicatula.*

" Loc. Katrore hills.

" *Terebratula intermedia.* (M.C. t. 15, f. 8.) *Var.*—A small specimen, and rather more deeply plaited than most of the European varieties of the species.

" *Terebratula biplicata.* (M.C. t. 90 and 437, f. 2, 3.) *Var.*—A variety of this variable species, found in the red chalk at Hunstanton, is precisely similar in form to our specimen, except that it wants the angle on each side of the beak, which is here obscurely visible.

" Loc. Jooria hill.

" *Terebratula sella.* (M.C. t. 437, f. 1.) *Var.*—A rather longer shell than the British fossil, and deficient in the central plait, which most generally occurs in full-grown individuals of that species.

" Loc. pass of the Hubbye hills.

" *Terebratula concinna?* (M.C. t. 83, f. 6.)—A larger shell than the one figured in M. C., and not so neat, but hardly possessing any character sufficiently strong to mark it as a species; there are, however, rather fewer plaits.

" Loc. Jooria hill.

" *Terebratula nobilis.*—Tetrahedral, rounded, sharply plaited; plaits about 16, extending to the beaks; 4 or 6 of them much elevated along the middle of the disk; beaks small and pressed; sides concave near the beaks.

"A large handsome species; when young, the general form is depressed, but the middle is even then much elevated. Length and width each 1¾ inch, depth of the valves united sometimes more than 2 inches.

"*Terebratula dimidiata?* (M. C. t. 277, f. 5.)—Whether this be *T. dimidiata or T. inconstans*, (M. C. t. 277, f. 4,) is a question the specimens are not perfect enough to settle. The flattened form of the specimen figured agrees with that of *T. dimidiata*, but the beaks of our specimens appear too much incurved (perhaps from pressure), and so to approach *T. inconstans*.

"Loc. Jooria hill, and near Charee.

"*Terebratula major.*—Transversely obovate, gibbose, plaited; plaits angular, extending to the beaks, about 30, half of them on one side of the front slightly raised; beak of the larger valve prominent, slightly incurved. A larger species than the last, of the same family, well distinguished by its width and even surface.

"Length, 1¾ inch, width 2¼ inches, depth of the valves united 1½ inch.

"*Buccinum pumilum.*—Ovate pointed, transversely striated; spire small; whorls 4, smooth in the middle, slightly convex; aperture ovate, pointed at both extremities. Height 3 lines, diameter 2 lines.

"Loc. Mhurr.

"*Belemnites canaliculatus, Schloth?* (Zieten, t. 21, f. 3.)—The fragments we have of this *Belemnite* agree well with Zieten's figure of *B. canaliculatus*, which is very probably not distinct from *B. sulcatus* of Miller. (Geol. Trans. 2nd series, vol. ii. part 2, p. 59, pl. viii. fig. 3.)

"*Belemnites* — ?—A nearly cylindrical fragment, without a sulcus, very like *B. elongatus* of Miller.

"*Nautilus hexagonus?* (M. C. t. 529.)—Flattened, spheroidal, with a very small umbilicus; front approaching to flat; sides rather conical; septa 15 in a whorl; aperture wider than long; siphuncle unknown. Diameter 3¼ inches, thickness 2¼ inches, length of the aperture 1½ inch.

"This differs from *N. hexagonus* in having a smaller umbilicus, and in being more rounded. It wants the lines that occur in the middle of the front of *N. lineatus*, which it nearly resembles.

"*Ammonites Herveyi.* (M. C. t. 195; Zieten, 19, t. 14, p. 3.) *Var.*—This differs from the English specimens only in having a wider umbilicus. It agrees well with Zieten's figure, which differs a little from the English specimens, to which *A. macrocephalus*, figured by the same author at tab. 5, f. 1 and 4, approaches nearer.

"*Ammonites elephantinus.*—Approaching to globose, with a very wide umbilicus exposing the inner whorl; whorls obtusely angular at their sides, crossed by very prominent rounded costæ, when divided into two, as they pass over the front; aperture transversely elongated, gently arched. Diameter 4 inches, thickness 2½ inches, length of aperture above an inch.

"*Ammonites formosus.*—Discoid, with a rounded edge, umbilicate, radiated; umbilicus narrow, acutely conical; radii numerous, slightly elevated, obscure near the umbilicus, often forked near their commencement, passing in a direct course over the front; aperture sagittate, with truncated angles. Diameter 5 inches, thickness 2¼ inches, length of aperture 1½ inch.

"*Ammonites lamellosus.*—Discoid, thick, with a rounded margin, umbilicate, radiated; umbilicus narrow, exposing a small portion of each inner whorl, smooth;

radii numerous, elevated into obtuse lamellæ, commencing with a curve upon the edge of the umbilicus, often forked upon the middle of the sides, bent forward as they pass over the margin. Diameter 4 inches, thickness 1¾ inch.

"*Ammonites Opis.*—Discoid, compressed, with an obtuse edge, radiated; inner whorls one-third exposed; whorls slightly convex on their sides, their inner edge rounded; radii, commencing with a curve at the inner edge of the whorls, numerous, prominent, rounded, often forked near the middle, slightly bent forward as they pass over the front; aperture elliptical. Diameter 4¼ inches, thickness 1¼ inch, length of aperture 1¼ inch.

"*Ammonites arthriticus.*—Discoid, thick, with convex whorls, and rounded margin, tuberculated and ribbed; whorls half exposed, about 4, their inner margin smooth; tubercles large, near the middle of the sides of the whorls, about 12 in each whorl; ribs prominent, rounded, 3 or 4 from each tubercle, and sometimes an intermediate one; aperture nearly circular, completed 3 or 4 times in each whorl with a thickened edge. Diameter 2½ inches, thickness 1 inch.

*Ammonites ignobilis.*—Discoid, depressed, umbilicated, keeled, radiated; front rounded, with a slightly prominent entire keel; umbilicus small, with squarish edges, exposing a small portion of the inner whorls; radii covering half the whorl, in pairs or forked, commencing and terminating with obscure tubercles, waved; aperture sagittate, narrow. Diameter nearly 3 inches, thickness 10 lines. Length of the aperture 1¼ inch.

"*Ammonites corrugatus?* (M. C. t. 451, f. 3.)—An imperfect specimen, rather more strongly ribbed than the one figured in 'Mineral Conchology.'

"*Ammonites armiger.*—Discoid, inner volutions exposed; inner whorls radiated, and furnished with a row of tubercles on their sides; outer whorls with a row of tubercles near the inner edge, and a row of spines near the outer edge on each side; the tubercles and spines connected by thick ribs; margin flat; aperture oblong, squarish. Diameter 7 inches.

"Strongly resembling *A. perarmatus* (M. C. t. 352), but the whorls increase more rapidly in size, and the aperture is longer. Probably *A. catena*, *A perarmatus*, and this, are only varieties of one species.

"*Crinoidal stems*, apparently of 3 species.

## *Coal.*

Before entering upon a particular description of the coal strata, which appear to be most developed in Eastern India, west of the Hooghly and Ganges, it is desirable to give further proof of their claim to a place in our Oolitic Series, and this can only be done in the present state of our knowledge by showing the connection of the latter with the carboniferous shales of Bundelkhund.

It will be remembered that Franklin found "black bituminous shale" cropping out "in all the glens" on the north-western side of Bundelkhund, "particularly in that of the Bagin river"; that Jacquemont found anthracite in the side of a well near Rampore; and that on the southern side of this sandstone tract Osborne found petroleum exuding from shale, with pieces of coal in the bed of the Son near

Bidjighur ; that about 40 miles east of this place the Son is joined by the Koyle, the banks of which are, according to Sherwill, composed of sandstone similar to that in which the "Rajhurrah coal mines" are situated, "18 miles from the Bahar boundary" ; and that 50 miles up the same river is Palamow, which, with its neighbourhood, has been the site of several coal operations ; while about 30 miles SE. of Palamow, again, is the source of the Damoodah, at which coal has been seen to basset; and here and there eastwardly all along the valley of this river to Burdwan, where I believe the coal deposits of this part of India were first discovered, as well as the vegetable impressions (ferns) referable to the Oolitic period. Lastly, the latter being identical with some lately discovered by the Rev. Mr. Hislop in the sandstone near Nagpore, which is that about to be described as forming the upper member of the Oolitic Series of India, we could not have a much more direct chain of evidence than this, in proof of the connection which exists between the bituminous shales of Bundelkhund and the great coal deposits west of the Hooghly and Ganges, and of their containing fossils belonging to the Oolitic Series generally.

*Carboniferous Deposits of the Oolitic Series in Bengal, West of the Hooghly and Ganges.*

These consist of coal, shale, and sandstone, but of no limestone, so far as has been observed ; and they appear chiefly to occupy the depressions of the granitic and metamorphic rocks which form this part of India ; becoming exposed in the banks or beds of watercourses or rivers which have passed through them, or in escarpments which have been produced by upheaval of the rocks on which they were deposited. Perhaps the most powerful agents of the latter have been the trappean effusions, which will be described hereafter.

The coal occurs in strata from an inch or less to 9 or 10 feet in thickness, interstratified with shale and sandstone, the whole possessing a dark black or blue colour, of a greater or less intensity. There is no particular order in this interstratification, either in the thickness of the strata, or in the kind of strata which follow each other. The coal may be between two argillaceous strata, or between two sandstone strata, or have a stratum of either on either side ; and the shale and sandstone strata may vary in thickness ; but the thickest beds of the latter far exceed those of the former. Sometimes the coal is close upon the surface, at others it is covered by a variable thickness of shale or sandstone. This probably depends on the amount of denudation which the strata may have undergone. In one section of a shaft sunk at

Palamow by Mr. Homfrey, 200 feet of sandstone superposed the first bed of shale and coal, which occupied 6 feet 1 inch, and then followed a stratum of 30 feet of sandstone before the next shale appeared. At Singra, in the same neighbourhood, 20 feet of sandstone superposed a bed of coal and shale 2 feet 2 inches thick, followed by a bed of sandstone of 18 feet, and afterwards thinner beds of coal, shale, and sandstone, for 20 feet 10 inches, succeeded by a bed of sandstone of 60 feet. At China Coory, also, in the vicinity, clay and shale 7 feet 6 inches first, was followed by a bed of sandstone 85 feet thick; at Ranigunge, sandstone 24 feet 6 inches, shale 39 feet, and then coal. In the computation of the section of the Curhurbalee coal field by Dr. M'Clelland, there are altogether 800 feet, of fine and coarse-grained, micaceous sandstone with conglomerates (the former prevailing) between the upper and lower groups of coal, shale, and sandstone strata.

Some of the coal measures are very shallow, from denudation or intrusion of igneous rocks, others are deeper. One shaft sunk by Mr. Homfrey at the mines of Ranigunge reached 210 feet, passing through 17 beds of coal, none of which were more than 16 inches to 3 feet in thickness, and of inferior quality. As, however, it is not my purpose here to give a summary of all the shafts and sections of the coal measures that have been made in these districts, but to point out their position generally, their development, and their geological relations, I shall conclude what I have to offer on them in this part of India by inserting Dr. M'Clelland's excellent account of the Coal-field of Curhurbalee, which will serve as a typical description for the whole.

The deposit of which this is a continuation "extends from the Damoodah coal-field north-west, along the valley of the Barakar to Curhurbalee, where it rests immediately on crystalline rocks, and is distinguished by the numerous valuable beds described in this report under the head of Curhurbalee Coal-field. It also extends at intervals (the particulars of which have not yet been surveyed) from the Adji valley north into the Rajmahal hills; where it is in one place found resting on conglomerate sandstone [Dr. M'Clelland's provisional "Old Red Sandstone," our Tara Sandstone, provisionally,] and a complete series of Silurian and Cambrian Rocks."

*"Curhurbalee Coal-field."*

"This coal-field surrounds the village of Curhurbalee, Pergunnah Curruckdyah, and is situated 60 geographical miles south of the Ganges, at Soorajgurrah. The coal-field is bounded on the northern and eastern

sides by fine table-lands, composed of gneiss (villages of Suliah, Bissunpore, Mohunpore, and Dundeedee).

"The southern boundary is imperfectly made out, the coal measures being cut off in this direction by quartz dykes and syenite (Buddeah, Gophai, and Lopsahdee villages).

"The western boundary rests on mica slate at the village of Peppratahn.

"The coal basin is 4 miles from east to west, and 2 from north to south.

"The coal measures are thrown up in tabular-shaped hills, which traverse the basin from east to west. The south-western declivities of these correspond with the gentle dip of the strata, while the north-western declivities consists of broken escarpments, formed by the edges of the uplifted strata.

"The lowest level of the coal basin is 800, and the highest 900 feet above the sea.

"The upper series of the coal measures, where they are exposed in the sections formed by the Sookneid rivulet (on the northern side of the basin), are as follows:—

"Sandy slate, clay varying in thickness from 10 to 50 feet.
"Compact claystone passing into clay ironstone, 10 to 20 feet.
"Slaty sandstone with mica.
"Slate clay, with thin beds of coal and shale, varying from 50 to 500 feet.
"Fine sandstone of uncertain thickness, with thin beds of coal and bituminous shale.

"The lower series of rocks composing this coal-field consists of hard thick-bedded sandstones, composed of earthy felspar, enclosing fine and coarse quartzoze nodules, from the size of grains of sand to that of small pebbles.

"This conglomerate rests on gneiss, or in some places on mica slate, and is in places intersected by trap and quartz dykes: it alternates with beds of coal, bituminous shale, and clay ironstone, in the following order:—

"A bed of bituminous shale occurs sometimes, either alone, or in connection with a thin bed of clay ironstone.

"In the latter case it is succeeded by a second bed of bituminous shale, followed by a bed coal, which is again succeeded by another bed of shale.

"It often happens that a similar repetition of shale, ironstone, and coal, occurs two or three times in succession, with a vertical section of 50 to 100 feet.

"When clay ironstone is not present, a bed of hard ferruginous sandstone usually occupies its place.

"The whole series of sandstone, coal, bituminous shale, and clay ironstone, are represented in the annexed computed vertical section, in order to show the alternation of the several beds, which are disposed in strata dipping towards the centre of the basin, at angles varying from four to twelve degrees with the horizon.

"The relative proportion of each member of this series to the general thickness of the whole, is as follows:—

| | |
|---|---|
| "Slate clay, arenaceous shales, &c. forming the upper measures. | 500 feet. |
| "Sandstone conglomerate.. .. .. .. .. .. | 1,700 ,, |
| "Coal, 20 beds, total thickness .. .. .. .. .. | 92 ,, |
| "Bituminous shale, 44 beds, including under-clays (which mean the same thing), total thickness.. .. .. .. | 54 ,, |
| "Clay ironstone 24 beds, total thickness.. .. .. .. | 16 ,, |
| | 2,362 feet. |

"The whole thickness of the upper and lower series of coal measures, both taken together, may therefore be estimated at 2,362 feet, as shown above, as well as in the computed vertical section. No limestone occurs in this coal-field, nor have any fossils been found, either in the sandstones, shales, or slate clay; but when the coal beds are once opened, sufficient fossil remains will then probably be found to throw some further-light on the subject."

Leaving this district, and proceeding westwardly from the neighbourhood of Palamow, where many shafts have been sunk, coal has been seen about 16 miles south of Chergerh, in the district of Singrowla (Franklin); 30 miles E. of Sohajpore, at the confluence of the Tipan and Son (id.); at Jubbulpore, in digging a well, more than 35 years since (Herbert); 33 miles south of Hoshungabad, on the road to Baitool (Finnis); and at Shapore in the same neighbourhood, discovered by Captain Ouseley (id.). In the Mahadewa hills, a continuation of the Satpoora range, 100 miles due north of Nagpore (Mm. Jerdon); also by the late Dr. Walker 10 miles from the confluence of the Godavery and Pranheeta, with bituminous shale, limestone, and sandstone above it, on all sides; and by his people in the form of anthracite in micaceous sandstone in a seam 3 feet thick at Duntinapelly, 20 miles from Sangaum, which is 65 miles west of Chinnoor. Dr. Bell, who has also been conducting a boring experiment at Kotah, in the same neighbourhood, has kindly favoured me with the following interesting and valuable section of this locality, from above downwards:—"Conglomerate of no great thickness; sandstone in hills from 50 to 500 feet in height;

argillaceous limestone, 9 feet; bituminous shale, ¾ inch; argillaceous limestone, 1 foot; bituminous shale, 4 inches; fibrous carbonate of lime, impure limestone, and blue clay rock, 8 inches; bituminous shale 2 feet 1 inch; laminated sandstone, 8 feet ¾ inch; bituminous shale, 1 foot 6 inches; fibrous carbonate of lime, 1 inch; bituminous shale, 1 foot 3½ inches; impure limestone, 5 feet 3¼ inches; black arenaceous clay, 3 feet 6 inches; sandstone, 23 feet; clay, 7 feet 6 inches; sandstone, 2 feet; clay shale, 1 foot 9 inches; limestone, 1 foot 8 inches; clay shale, 12 feet; red marl, 27 feet, and limestone which was only penetrated to the extent of 2 inches." Lastly, the late Captain Kittoe has given sections of coal strata at Talcheer and Ungool in Cuttack, where the coal is found within 13 feet of the surface, which, from the micaceous sandstone that accompanies it, is in all probability part of the formation we have just been considering. In the Oolitic sandstone of Cutch it was long since discovered by Colonel Grant.

Under the head of "Garrawarra," which is a town on the south side of the Nerbudda, about 80 miles above Hoshungabad, Ansted, in his "Elementary Geology," p. 541, states:—"On the Seeta Rewar river there appear to be three beds [of coal], whose thickness is 20, 40, and 25½ feet respectively: these are covered with a thin bed of sandstone." Again, under the head of "Jubbulpore," he states:—"At 9 miles from the station there is a large bed of first-rate quality, many yards thick, crossing the bed of the Son." The nearest part of the Son to Jubbulpore is 40 miles distant, so this would appear to be the largest bed yet discovered. No authorities are given.

*Geographical Extension.*—The extremes of this coal formation, so far as have yet been discovered in the tract of India under consideration, *including* the angular portion beyond Delhi and Ferozepore, are: the confluence of the Godavery and Pranheeta in the south, in about 19°, and Nahn, in the Sub-Himalayan range, in about 30° 30″ N.; Cutch Bhooj in the west, and Burdwan, about 50 miles NW. of Calcutta, in the east. But by far the greatest number of places in which it has been noticed, indeed I might say almost the whole, with the exception of the northern and southern extremes, are between the 20th and 25th parallels of latitude; and here the greatest development of this formation appears to be in the east, expending itself out towards the west. In the districts of Burdwan, Birbhoom, Monghyr, Ramghur, and Palamow, its great development appears to be at the expense of the upper and under sandstone, together with the limestone, for these are frequently unrecognisable, particularly in the first-named districts, where the coal formation appears to rest chiefly on the granitic or metamorphic

rocks. There are many other places, no doubt, between Bengal and Bahar on the north and east, and Orissa and Berar in the south and west, respectively, where this valuable mineral may be found; but it remains for future explorations to prove it more satisfactorily, and to point out whether the coal is so situated with respect to other minerals or water carriage as to make its working worth the consideration of the Government of India, or the speculation of a private company. Poor Voysey! who travelled through this country from Nagpore eastwards to Calcutta, through Sumhulpore, and met with black slaty limestone, black calcareous clay slate and sandstone on his way thither, states of them at Lowan and Bellagurh:—"I am convinced that the rocks of this formation are contemporaneous with, and [or?] prior to, the granite." But he did not live to communicate more about them, for he died (of the fever mentioned in his Journal) between the left bank of the Subunreeka and Calcutta, having been found in his palanquin 24 hours after his death.

For an analysis of this coal I must refer the reader to the table on this subject published in vol. vii. of the Bl. As. Jl. p. 197, which was extracted from one of the Reports of the Coal Committee. To this I have only to add, that the coal occasionally presents the spheroidal structure common to many formations. The so-called "Ball-coal" sent by Mr. Williams from the Burdwan mines to Mr. Piddington is of this kind, the spheroids of which are from the size of a "cannon-ball to a man's head"; some are 18 inches in diameter. Mr. Piddington states that the apparently concentric layers are oblique "rhomboidal prisms."

The following vegetable impressions from the "Sandstone and Clay, with beds of Coal," in Cutch, are described by Mr. J. Morris, at the end of Captain Grant's Geology of that province:—

"*Ptilophyllum.* — Stem —? Fronds pinnate; pinnæ closely approximated, linear, lanceolate, more or less elongate, imbricate at the base, attached obliquely; base semi-circular or rounded; veins equal, slender, parallel.

"*Obs.*—We have ventured to form these fossils into a distinct genus, conceiving that the circumstances of the oblique insertion of the pinnæ, and their overlapping each other at the base, are characters too important to admit of their being united to the genus *Zamites*, to which some similar fossils have hitherto been referred. The *Z. pectinata* of the "Fossil Flora" belongs to this genus, and a careful revision of the fossil *Cycadeæ* may probably discover other species having this mode of attachment. From the structure of the frond they may, however, be considered to belong to *Cycadeæ*, and to differ from *Zamites* in the oblique insertion of the pinnæ at the base, and from *Coniferæ* by the absence of a primary vein in the pinnæ.

" *Ptilophyllum acutifolium.*—Frond pinnate; pinnæ narrow, linear, elongate, acute at the apex.

" This species differs from *Z. pectinata* of the " Fossil Flora," in its pinnæ being narrower, longer, and more acute; and more nearly resembles the *Polypodites pecteniformis of* Sternberg.

" *P. Cutchense.*—Frond pinnate; pinnæ short, scarcely overlapping at the base; apex obtuse.

" This specimen has also been referred to the genus, from its pinnæ (although wider apart than in the other species) having apparently a rounded base; but the absence of all trace of venation in this fossil must render its correct determination very doubtful. It resembles in form the *Z. Bucklandii* of Sternberg, (parts 5 and 6, t. 23. f. 2,) or even *Z. taxina* of the " Fossil Flora," and it might also be compared to some pinnatified *Polypodiums*, as *P. plumula* and *P. taxifolium.*

" *Lycopodites affinis.*—Stem —? Branches linear, elongate, leaves distichous, alternate, ovate, lanceolate, acuminate, aduate at the base.

" This specimen has been referred to *Lycopodites* from its resemblance to the barren portions of *Lycopodium Jussieni* and *L. volubile.*

" *Fucoides dichotomus.*—Frond compressed? dichotomous, branches unequal, patulate, apex obtusely rounded.

To the " Report of the Geological Survey of India for the Season 1848-49," Dr. M'Clelland has appended the following descriptions of vegetable impressions found in the Burdwan Coal-field :—

" *Burdwan Fossils.*"

" I may here add in this place the following undescribed fossils of the Burdwan coal-field, which may serve as a term of comparison between the Burdwan and other coal-fields generally: most of them are in the collection of the Asiatic Society.

"*Zamia Burdwanensis.*—Leaflets linear-oblong, broadly inserted at the base, and rounded at the apex.

" *Sphœnophyllum speciosa.*—*Trizygia speciosa,* Royle's Illust. 2. Fig. 8.—Leaves verticillate, fan-shaped, frequently bi-lobed; placed in threes at intervals on a slender floating stem.

" *Obs.*—There can be no doubt of this being a well-marked *Sphœnophyllum,* having the furrowed stem and bifurcated venation of that genus.

" It is the most beautiful fossil hitherto found in the Burdwan coal measures.

" *Sphœnophyllum fasiculatum.*—Leaves verticillate, fan-shaped, in dense imbricated fasciculi, probably at intervals, on a slender floating stem. Discovered by Mr. Theobald in the Burdwan coal formation.

" This fossil occurs in the form of detached lenticular bodies, from half an inch to an inch in diameter, and is so abundant as to give quite a character to some of the upper beds of bituminous shale of the coal formation.

" *Obs.*—From the shape and detached character of these bodies, they might be supposed to be the strobili of some coniferous plant, and, being composed of an infinity of densely imbricated scales, may still prove to be of that nature. But the fine leafy and membranous character of the scales, presenting the venation of *Sphœnophyllum,* suggest the probability of their being dense whorls of leaves or fronds.

" *Poacites muricata.*—Leaf long and ensiform, upwards of an inch in breadth, and consisting of parallel unconnected veins.

" *Obs.*—It occurs in the Burdwan coal-field, along with *Fucoides venosus.*

" *Poacites minor.*—This is an ensiform leaf, usually half an inch in breadth, and of indefinite length, consisting of seven or eight coarse, longitudinal, equal veins, without any transverse connection with each other.

" *Obs.*—It is found in bituminous shale in the Rajmahal and Burdwan coal measures; and also in arenaceous shale in the Burdwan coal-field.

" *Glossopteris acaulis.*—Spreading and stemless; the fronds long, stipitate, linear-oblong, becoming irregularly narrow at the base; apex broad, obtusely pointed; primary veins bifurcate; secondaries and tertiaries reticulate.

" *Variety.*—In which the primary veins are dichotomous, and the secondaries bifurcate.

" *Glossopteris frondosa.*—Fronds oblong ovate, midrib slender, and continued to the apex of the frond; veins slender, diverging at an obtuse angle from the midrib; all of an equal size, and reticulated.

" *Obs.*—Only two incomplete fragments of the upper and middle portion of the frond have been examined, from which it would appear to be from 4 to 8 inches in length, and 1½ to 3 inches broad.

" *Glossopteris reticulata.*—Leaves oblong, ovate; narrow at the base; apex obtuse, lanceolate; midrib strong, gradually tapering, and terminating before it reaches the apex; primary veins close-set and numerous, curved, and arising acutely from the midrib; secondaries finely reticulated.

" *Tæniopteris danæoides.—Glossopteris danæoides*, Royle, Illust. l. c.—Frond ovate; veins bifurcate, parallel, without tertiary veins.

" *Obs.*—Various specimens show the fronds of this fossil to have been from 3 to 5 inches in length, and from 1½ to 2½ in breadth.

" *Note.*—Calamites occur both in the Burdwan and Rajmahal coal measures, but I have seen no specimens of them in collections. One large species occurs in the saudstone of the coal measures at Kottycoon, in the Rajmahal hills, of which, however, no specimens were collected.

" *Pecopteris Lindleyana*, Royle.—Bi-pinnate; pinnæ given off nearly at right angles with the midrib, linear-oblong and oblong-ovate; secondary pinnules having the vein in the centre of each pinnule nearly straight, and extending from the base to the apex of the pinnule, giving off obliquely six to ten small branches or tertiary veins on either side.

" *Variety.*—Secondary venule in the centre of each pinnule more curved, and acute at its origin; probably a distinct species, but the specimens examined are too imperfect to allow of the satisfactory determination of this point.

" *Pecopteris affinis.*—Bi-pinnate, central vein of each pinnule bifurcate; in other respects it is the same as *P. Lindleyana.*

" *Variety.*—Pinnules closely placed, so as to appear almost as the lobes of an incised leaflet.

" *Fucoides venosus.*—Frond simple, membrano-fleshy, hidden veined, spatulate, linear-oblong, base prolonged and narrow; apex obtuse and rounded; midrib broad at the base, gradually diminishing to the apex; the venation, where it is perceptible, is acute with the midrib, and arched. This fossil is contained in bituminous shale of the Burdwan coal-field.

*" Conclusion derived from the foregoing Fossils."*

*" Obs.*—Comparing the above results with the general distribution of fossil plants, we find four genera, namely, *Zamia*, *Tæniopteris*, *Fucoides*, and *Pecopteris*, afford twenty species of lower Oolite fossils, and eleven coal measure fossils. Of eight genera of Indian coal measure fossils here described, four of them are common to the coal measures of Europe, namely, *Sphænophyllum*, *Poacites*, *Calamites*, and *Pecopteris*."

To these may be added Royle's *Vertebraria Indica* and *V. radiata* from Burdwan, figured in pl. ii. of his " Illust. Bot. Himalaya"; and Brongniart's *Glossopteris Browniana* and *G. Angustifolia*, from the Ranigunge mines, near Rajmahal.

Also the two Icthyolites found by Drs. Walker and Bell respectively, at Kotah, in the Nizam's territories, near the confluence of the Godavery and Pranheeta. That of the former, named by Colonel Sykes *Lepidotus Deccanensis*, in " bituminous schiste," is stated by Sir P. Egerton, who examined these organic remains, to be a new species. " The scales are perfectly smooth, and the free posterior margins entire, without any trace of serration. A ramus of the lower jaw is seen in one specimen, showing the teeth to be conical, with rather elongated bases. There is little doubt but that it is a true Oolitic form, and apparently of the date of the Lias." " The genus Lepidotus was probably an estuary or in-shore fish, from its frequent association with terrestrial vegetable remains, as in the Hyderabad specimens."

Of the specimen submitted by Dr. Bell to the Geological Society, and which Colonel Sykes has named *Dapedius Egertoni*, Sir P. Egerton states :—

" It belongs to the genus *Dapedius, with single-pointed teeth ; Tetragonolepis* of Agassiz—not of Brown. It appears to be a new species, differing from those hitherto described, in the ornamental pattern of the scales. It is an Oolitic form, probably of the age of the Lias."

This fossil was found " in a slab of limestone," and therefore, should properly, have been placed under the head of " Limestone" in this sub-series ; but this matters little, as by-and-bye these strata must be grouped according to the kind of organic remains which they contain, and not according to their mineralogical characters.

The following list of fossils from Cutch, and the Desert to the north-east of that province, which were described by Mr. J. de C. Sowerby to illustrate Colonel Sykes' observations on them in vol. v. of the Geol. Trans. 2nd Series, should have accompanied those extracted from " Grant's Geology of Cutch," p. 215 :—

*Astarte major*, *A. compressa*, and *A. rotunda ; Corbula pectinata ; Trigonia Smeeii ; Tornatella striata ; Terebratula microrhyncha ; Ammonites Mya*, *A. calvus*, *A. Pottingerii*, *A. fissus*, *A. torquatus*, and *A. Fornix*.

## Punna Sandstone. (H. J. C.)

This name is derived from the town of Punna, in Bundelkhund, above which is a range of hills called by Franklin the " Punna hills or Second Range," but which Jacquemont, as before stated, found to be a third range.

*Synonyms.*—Diamond Sandstone (Malcolmson). Upper part of Voysey's "Clay Slate Formation."

It is to be regretted that Jacquemont, who first pointed out the existence of this range, was not able to explore more than the lower part of it, which the following extract from his work will show is composed of sandstone resting on the Kattra Shales :—"Je ne suis pas monté sur leur sommet [the Punna hills]; leurs pentes sont couvertes de bois, que plusieurs espèces de Mimoses rendent d'un accès très-pénible; mais je me suis élevé jusqu'à leur hauteur moyenne, dans le lit de quelques ruisseaux qui en descendent. Les fragments dont ils sont remplis sont une table abrégée des couches qui constituent les assises supérieures. Or, je n'y trouve qu'une seule variété de Grés, plus rouge qu'aucune de celles que j'ai observé dans la première et la deuxième rangée, lie de vin clair, à grain très fin, compacte. Quelques-uns de ces Grés sont mouchetés de blanc, et ressemblent grossièrement à des porphyres. Ces points blancs sont des parties ou l'oxyde de fer n'a pas pénétré." He then observes :—"Les seuls bancs de Grés que j'ai vus à découvert, vers la base des collines, offraient la structure concentrique que j'ai remarqué dans les couches de la base de la première rangée en montant de Mirzapoor a Lalgandje, mais avec cette différence que leurs surfaces étaient plutôt planes que courbes. Ce sont des sortes de parallélipipèdes emboités les uns dans les autres." I have added the latter observation because it coincides with a similar structure noticed by Captain Sherwill "at the foot of the hill of Sasseram, in the zillah of Shahabad, which forms the termination of a spur thrown off from the northern face of the lofty range of the Keymore sandstone mountains." This is at the eastern extremity of the sandstone tract of Bundelkhund, which we shall also find by-and-bye to be composed of nothing but the Punna Sandstone, resting on the Kattra Shales with their limestone, croping out at Rhotasghur and other places close by. The structure is so remarkable, that it has received a particular description by Captain Sherwill, who, like Jacquemont, first terms it "concentric," and then observes, that "the pressure above and laterally has caused them [the spheres, which are in rows,] to be so much flattened that they resemble square columns."

To return, however, to the plateau of Bundelkhund. We find that Franklin, in describing the escarpments of four waterfalls, ranging from 272 to 400 feet deep, all along the same declivity, and within 40 miles of each other, states, that they are all composed of the same sandstone formation; and in one instance, that it rests on argillaceous

strata. The latter fact establishes the identity between it and the Punna Sandstone. Moreover, the easternmost waterfall is not more than 30 miles from the banks of the Son, which banks we shall by-and-bye find to be composed almost entirely of the Punna Sandstone, resting, as before stated, on the Kattra Shales. Fortunately Franklin has been particular in his description of this sandstone at each of the waterfalls, and therefore from his and Jacquemont's observations, we shall be able to take our description of it from Bundelkhund, assisted by the remarks of others who have incidentally alluded to it, in this part of India.

*Mineralogical and Geological Characters.*—From these sources, and the specimens I have seen of this sandstone, it appears to be composed of very fine grains of quartz, and more or less mica, united together by an argillaceous material. The latter varies in quantity, and the mica may be entirely absent. It seems generally, to be of fine structure, and coloured with different tints of red, brown, lilac, grey, and white, or any two of these together, the one forming streaks, spots, or specks, in a ground of the other. Superiorly it appears to be compact and quartzy, becoming more friable and loose below. It has been horizontally deposited, and now presents massive and lamellar strata.

To these characters it appears necessary to add, that its texture may become so coarse as to pass into a conglomerate; at the same time that it is also necessary to caution the observer against confounding this conglomerate with one, apparently of subsequent formation, which may overlie this sandstone, and which will be hereafter mentioned.

The Punna Sandstone rests conformably on the Kattra Shales, which appear to pass into it, in the same manner as the Tara Sandstone passes into the latter. In some places in Southern India it rests directly on the limestone, without the intervention of any shales (Malcolmson).

Its thickness varies, either from original inequality or subsequent denudation. At present its greatest known depth is in the eastern part of the Keymore range, which is but a continuation eastwardly of the Vindhya range, and the north-eastern part of the sandstone tract of Bundelkhund. Here, it is 700 feet thick, near Bidjighur on the banks of the Son (Osborne), and 1,300 feet thick at Rhotasghur, in the zillah of Shahabad (Sherwill); at the scarps of the waterfalls in Bundelkhund, which were examined by Franklin, it does not appear to exceed 360 or 400 feet, and Jacquemont considered the Punna range of hills to be about 300 feet above the level of the second plateau. From 300 to 400 feet is the thickness given to it in South-western India, about Ryelcherro and Sundrogam, in the Ceded Districts

(Newbold). On the opposite side, however, viz. at Paloonchati, about 15 miles west of the Godavery, and in nearly 18° N. there is a range of entire sandstone hills, which appear to rest on argillaceous strata, that Voysey considered 600 feet high, but which Mr. Burr, who was then surveying these districts, thought 1,200 feet high. The falls of Gokak present a sandstone escarpment of only 178 feet high, with aluminous shales of various colours at the base (Newbold). In many places this sandstone is not only much thinner than this, but altogether absent, when the limestone or argillaceous strata of the Shales becomes the highest member of the series, as in the neighbourhood of the Bhima, in the district of Shorapore, &c.

It attains its greatest height on the banks of the Kistnah, viz. 3,000 feet (Malcolmson), while in the plains of the Carnatic, and the districts watered by the Penaar river, it is but a little above the level of the Sea (id.).

Frequently its upper part is in the state of quartz rock, presenting great fissures; occasionally also, in Southern India, it has a jointed rhomboidal structure (Malcolmson), and sometimes the concentric lamellar one. Christie and Newbold mention this in the Southern Mahratta Country, and the latter also at the Gundicotta pass: to its existence at Sasseram and in Bundelkhund I have already alluded. It is also sometimes brecciated from volcanic disturbance and subsequent reconsolidation.

The hills or mountains capped with this sandstone and the shales, generally, present a scarp of the former followed by an inclined plane of the latter, while the summit is either horizontal, or terminated by a rugged fantastic outline, not unlike old ruins.

Subject as this series has been throughout to the intrusion of igneous rocks, and the violent displacement which accompanies subterranean force, the Punna Sandstone has of course participated in the general overthrow, and appears in all kinds of positions and conditions; but no one mentions the intrusion into it of anything but dykes of the trappean rocks. Malcolmson states, that a few miles north of Nagpore the strata of "red sandstone are bent, fractured, and converted into compact quartz rock, at their point of contact with the granite, which has burst through it"; but I am not quite sure if this be the sandstone under consideration.

When metamorphosed into quartz rock, it would appear to have been sometimes called "hornstone." Tod, I think, calls it "trap"! in alluding to the formation of the plateau of Kotah in Mewar. He observes that this plateau consists of "trap," the prevailing colour of

which is white; it is of a compact and close-grained structure, of a white colour; and about Kolali, porphyritic; at Shahadabad, it is of a mixed red and brown colour, and when decomposed would be taken for a "gritstone." Dangerfield sets it down in his geological map of Malwa as "hornstone porphyry," the same as the ridge bounding the trap of Malwa close by, which rests on the shales; and Hardie gives a similar description of the capping of the hill of Chittore, which Tod includes in the district or plateau of Kotah. Hardie, however, calls this "quartzoze breccia," and states that it presents scarped sides, which terminate in a sloping plane of the shales on which it rests. We can hardly, I think, fail to recognise in this the Punna Sandstone. Sherwill, again, in his description of the Rajghur hills, of the Zillah Bahar, calls the latter "hornstone," and adds that they present lively colours of red, purple, blue, greyish-green, &c. Newbold mentions a similar rock in the Eastern Ghauts west of Nellore, and considers it to be altered sandstone. The quartz hills of Ajmeer, of a violet or purplish tint, and indeed all those alluded to by Tod, appear to be the Punna Sandstone metamorphosed; although I have placed them among the older Metamorphic Rocks, but this is only done provisionally.

*Geographical Extension.*—The Punna Sandstone appears to be almost unlimited in its extent over the tract upon which we are engaged. It appears to be present at Nahn in the Sub-Himalayan range, between the tributaries of the Jumna and Sutlej, and to extend as far south as the Nagerry hills, in the Eastern Ghauts WNW. of Madras, to Cutch in the west, and to the Rajmahal hills in the east. Grant states that the hills about Bhooj "assume, when capped by the sandstone, the usual form of an abrupt escarpment, with a long inclined opposite side." All the towns on the Jumna, from its confluence with the Ganges to Delhi, appear to be built of this sandstone, and among their edifices stands forth the Taj Mahal, edged with the beautiful white metamorphosed limestone of this? series.

The plains of Bikaneer, Jodpore, and Jessulmeer, appear to be covered with the loose sand of this formation, which every now and then projects above these dreary wastes in its concrete or metamorphosed forms. Our museum possesses specimens from Balmeer presented by Dr. F. Forbes; from Cutch, and from Kattyawar. It borders the northern and western sides of the trappean tract of Malwa (Dangerfield), and appears in the Bundair hills of Bundelkhund, on its eastern side, extending to the utmost limits of the Vindhya range, which in this direction may be said to reach Monghyr, on the Ganges. Westwards to Hoshungabad; and on the opposite side of the Nerbudda,

forming the north-eastern boundary of the great trappean tract of Western India, from which we have numerous specimens from Dr. Bradley; appearing at Nagpore, and extending from thence along the Godavery to its debouchment. In the Southern Mahratta Country, on the Bhima, along the Kistnah, and more or less continuously on the eastern side of the peninsula from this river to the Nagerry hills, beyond which its existence has not been recognised, nor does it appear to have been seen on the western side from the Ceded Districts to Cape Comorin.

*Minerals.*—If the quartz mountains of Ajmeer be this sandstone metamorphosed, then it contains lead, as has before been stated; and when we remember that the limestone about Cuddapah, which is intimately connected with this sandstone, contains galena in several places, it does not seen very improbable. Further than this I know of no other mineral worth working in it. In the introduction, it is stated that the Oolitic Series yields iron ore, but as yet I think there is no satisfactory evidence of its existence in it to any great extent, at all events in the unmetamorphosed condition of the strata. The resources of this series appear to be more economical than mineral; at the commencement of the group I have, by mistake, used the latter word, which is, perhaps, more applicable to the Older Metamorphic Strata. In what "clay-slate" is the copper of Nellore, &c.?

*Organic Remains.*—For many years past the sandstone of India has been known to yield impressions of plants. Captain Dangerfield, in his letter to Sir John Malcolm on the geological features of Malwa, written more than thirty years since, states that he saw between the slaty fracture of the sandstone at Jeerun, in Malwa, passing northward to Odeypore, "numerous vegetable remains or impressions of a species of fern, appearing to be in a carbonized state," and we know now sufficient to reasonably infer that this is the sandstone under consideration.

Grant, about 1837, found the impressions above described in the "sandstone and clay with beds of coal" in Cutch. We have only one specimen of the Cutch sandstone bearing a vegetable impression in the museum, and that very closely resembles the fine micaceous sandstone at the north of Elichpoor, and that in the neighbourhood of Nagpore, which also bears vegetable impressions.

But it is only within the last year that our attention has been forcibly drawn to the organic remains of this member of the Oolitic Series. The happy coincidence of a favourable locality and able inquirers have furnished us with a list of fossils that will establish a lasting interest in the organic remains of this sandstone, and soon set at rest all

discussions respecting the geological age of the series to which it belongs. I allude to the researches of the Rev. Messrs. Hislop and Hunter, whose "Geology of the Nagpur State" is published in the last number of our Journal, and from which the following descriptions of the fossils in the sandstone of Nagpore are extracted:—

"*Mollusca.*—These occur only at Máugali, 60 miles south of Nagpur, and consist of two species of minute *Cyrena*, (?) one, which is the smaller, being globular, and the other flatter and more elongated.

"The vegetable remains are exceedingly abundant, and are to be found in all places where the middle beds appear. They have also been recently discovered in a similar position near Elichpur, by Dr. Bradley. As they are met with at Nagpur and the surrounding country, they include seeds, leaves, and stems.

"*Seeds.*—Four species. Of these the first two discovered were found at Bhokára. Notwithstanding their being smaller, they are evidently related to two of the forms of *Carpolithes* figured by Lindley and Hutton in their *Fossil Flora*, vol. iii. p. 193. The third kind of seed was first met with at Kámpti, by Mr. Sankey, to whom I am under many obligations for this, as well as other favours. Shortly after Captain Wapshare and I found it at Tondakheiri, 14 miles NW. of Nagpur. A fourth seed, which occurs at Silewádá, is lanceolate, and very minute. Under this head may, perhaps, require to be comprehended a circular depression, resembling in size and form the impression left on wax by a pretty large key, which was discovered by Captain Wapshare at Bhokára.

"*Leaves.—Dicotyledonous* 2. One a leaf of a conifer, about 1 inch long and $\frac{1}{5}$ inch broad across the middle, midrib included. It has obviously been a strong inflexible leaf, and with its sharp point may have been rather formidable. A small piece of *Zamites* from Kámpti, not $\frac{1}{2}$ inch long, and yet it gives off from its tiny midrib 20 pinnules, each containing 6 or 7 microscopic veins. There are several leaves observable in the strata at Kámpti, apparently *Monocotyledonous*. One kindly contributed by Mr. Sankey is 17 inches long and $\frac{3}{4}$ inch broad. Before deposition it had been split in two for about two-thirds of its length. It may possibly be the leaflet of a large *Zamites;* but I am disposed to consider it rather a *Poacites*, with very minute venation. The same may be said of another curious object, which has left 42 parallel lines stretching across a confused mass of vegetation, for a distance of 3 inches, and with a breadth of $\frac{3}{4}$ of an inch.

"But the most common and beautiful leaves which the sandstone formation produces are the fronds of ferns. They include —

"*Pecopteris.*—Of this genus but few specimens have been found, and these at Kámpti only. They are, however, of two distinct species. A pinna belonging to one of these species is furnished on each side with 11 pinnules, with a central vein, reaching to the apex. A specimen of the other species is very perfect, and presents four bipinnate fragments, lying together in such a manner as to indicate a tripinnate frond, pinnæ with from 8 to 10 pinnules on each side, the venation much branched, and without a central vein extending to the apex.

"*Glossopteris.*—The species of this genus are very numerous, amounting to 10, and all in excellent preservation. With their large iron-coloured fronds and distinct veins, and in several instances with their perfect fructification, they form the most interesting fossils of the vegetable kingdom that I have ever seen. The species differ from each other in size, shape, venation, and arrangement of the sori. One of them is upwards of 20 inches long and 3 broad, while some slabs are entirely covered with a species little more than 3 inches in length. Some have the venation coarse, others fine; some have it starting from the midrib at a very acute angle, others nearly at right angles. The sori in all cases are dot like; but in some they are large and round; in others they are small and elongated; in some they are placed chiefly along the margin, in others with 4 or 5 rows they fill up almost the whole of the frond. This genus is the most widely diffused of any in the formation within the Nagpur State. It has been found at Chándá, and also at Chorkheiri, a distance of 120 miles, and at intermediate places. The locality that has furnished most species is Silewádá, whence I was favoured with a magnificent slab by Captain Wapshare.

"*Cyclopteris.*—One species of this genus has been discovered at Tondakheiri, along with the coniferous leaf; length 2½ inches, breadth 1 inch. The frond is crowned with fructification in form like the flower of a cultivated cockscomb. Another species met with at Kámpti is much larger.

"*Sphenopteris.*—The specimens of this genus which are imbedded along with those of *Pecopteris* are much mutilated; but the small fragments that are found exhibit a very elaborate, though clear, venation.

"*Tæniopteris.*—Two species, one narrow, with secondary veins straight and perpendicular to the median; the other very broad, with secondary veins curved and oblique.

"*Stems.*—These are very abundant at Silewádá, including genera of which I can find no traces in any *Fossil Flora* to which I have had access. They are apparently *Exogenous*, but do not preserve the

structure of the wood. They have possessed a well-defined bark, which is often obliquely striated, and exhibits the cicatrices of leaves, with a bud occasionally left after the foot-stalk had fallen off. Some of the scars are longitudinal; others are transverse, and embrace a considerable part of the stem. They are in general sparsely distributed, in one large stem 3 feet long, and upwards of a foot broad, there being only a single scar apparent. Besides these *Exogenous* stems, of which there are four or five different genera, there was one discovered at Mángali, along with *Cyrenæ*, which can be distinctly referred to the conifers, from the lattice-like disposition of its scars. The wood of a coniferous stem, converted into silex, but retaining no traces of its bark, was dug out from the road near Chándá. Other stems, preserving the wood, but so altered by iron that the structure cannot be determined further than that it must have been *Exogenous*, occur in abundance at Silewádá. On the other hand a stem embedded in the rock at Mángali exhibits every mark of having been *Endogenous*. The portion obtained is like a thin rattan, 14 inches long, without any apparent joint. Under this sub-kingdom must also be classed—

"*Equisetites*, or according to Bunbury *Asterophyllites*.—The peculiarity of the specimen of this genus, which was discovered by Mr. Hunter at Silewádá, as well as of a Yorkshire one, figured in the *Fossil Flora* (vol. iii. p. 186) under the name of *Equisetum laterale*, is, that it is always found associated with little round discs, having 'lines radiating from a common centre, something like the phragma of a calamite.' The authors of the *Fossil Flora* were uncertain whether the discs belonged to the stem, near which they are found; but in the Silewádá specimen, the round bodies, of which there must have been two and two opposite each other at the articulation, partly retain their original position, and partly have fallen out, leaving a radiating hollow to show where they once had been. A very common plant at the deposition of the sandstone was the—

"*Phyllotheca*.—In giving this name to the genus that has hitherto been called *Calamites* in India, I follow the high authority of Brongniart and McCoy, who have described specimens from Australia. The opposite sulcation of our Indian genus clearly separates it from *Calamites*. What place it ought to hold in a classification remains doubtful. Göppert ranks it among Monocotyledons, immediately after *Equisetites*, while McCoy compares it with the *Casuarina*. I have not been able, in the numerous specimens which I have met with, to verify the opinion of the latter eminent geologist, not having detected either bark or a phanerogamous fructification. There appear to be in

all nine species collected from Bhokára, Silewádá, and Kámpti, differing in the number of *sulci*, which range from 6 in the semi-circumference to 31. Two from Kámpti were sent to me by Mr. Sankey, and one from Silewádá by Captain Wapshare.

"*Vertebraria*.—This is the strangest genus among our Nagpur fossil plants. Hitherto it has been described from specimens obtained exclusively from the Indian and Australian coal-shale. This has led to a limited view of its nature. McCoy's generic character applies merely to the radiated body, which is found in connection with the main stem, and which he believes to be made up of a 'slender stem surrounded by densely aggregated whorls of verticillate cuneiform leaves, having a dichotomous venation.' Of the correctness of this description of what was before the author at the time, I have no reason to doubt, but it is quite inappropriate, when it comes to be predicated of the sandstone specimens. These have no slender stem or densely aggregated whorls of leaves. On the contrary, the main stem is thick, marked with two rows of oblong, rounded, or angular elevations and depressions, and giving off branches and twigs at different intervals, and in all directions. Mr. Sankey forwarded to me the first sandstone specimen from Kámpti, and in the same week I found it at Tondakheiri, and more recently at Chándá.

"Such are the principal fossils of the Sandstone, properly so called. Beneath it occur some beds of Shale, which may be held as part of the same formation. These strata are developed in the district north of Chándá, and between Korhádi and Bhokára, where the red shale contains the following organic remains:—

"*Reptilia?*—A footmark, of $\frac{1}{3}$ of an inch long, and as much broad, with the impression of five (?) claws. Three specimens have been obtained, each exhibiting only one print. The shale, which is very brittle, does not admit of a surface of more than a few square inches being procured. On the same specimens as bear the footmarks are seen the tracks of—

"*Lumbricariæ* (Earthworms).—That these animals have been of the nature here indicated will be evident to any one who considers the appearance of the furrows: the way in which the head has occasionally been pushed forward, and then withdrawn; the tubular holes by which the ground has been pierced, and the intestine shaped evacuations which have been left on the surface. Worm borings have been found in the green shale of Tadádi, 70 miles south of Nagpur.

"The only vegetable organism which has been discovered in the shale is a sulcated plant, which most probably belongs to the genus

*Phyllotheca*, but, as a sufficient length of the stem has not been obtained to display the articulation, its precise character cannot be fixed."

Dr. Spilsbury sent to the Bengal Asiatic Society a specimen of silicified wood, which Captain Ousely obtained from a trunk of a tree that he observed passing through a cavern in this sandstone, near Pugra, on the left bank of the Nerbudda, on the road from Tendukira to Baitool. Do the "silicified palm trees" which Dr. Spry describes as resting on *limestone* about a mile from Saugor, belong to this formation, or to the thin intertrappean lacustrine one, to which we shall come by-and-bye? The Rev. Mr. Hislop states in his paper, that silicified wood abounds at Silewada; and Malcolmson observes that Mr. Geddes found it strewed over the country NW. of Mangapett on the Godavery, towards the junction of the latter with the Wurda, (Pranheeta?) which is in this Sandstone Formation; while Malcolmson himself found "coniferous" wood at Mangapett, resembling that of Pondicherry. But the latter may also have come from the lacustrine formation to which I have just alluded.

Newbold saw ripple marks in this sandstone at the falls of Gokak, and at the pass of Gundicotta.

## Minute Coralline Limestone of Baugh.

There is a fossiliferous limestone, of which much of the ornamental architecture in the once famous city of Mandoo, situated in the Vindhya range, about 160 miles up the Nerbudda, is constructed, and which differs from any other in India that I have seen described. Specimens of this limestone were presented to the Society by the late Lieutenant Blake, among other many valuable contributions of the kind which this officer made to the museum.

It is of two colours, red and yellow, mixed with white, and of a coarse, compact structure. This coarseness, when examined with a Coddington lens, in a polished section, is found to depend on the presence of innumerable microscopic corals; and the colour, on oxide of iron, which is diffused through two-thirds of the mass. Many of the corals are branched, and their cellular arrangement varies with the species; of which there are several. The most prevalent appears to be one in which the cells radiate upwards and outwards in a curved form from the longitudinal axis, in the manner of *Favosites*. The points most worthy of mention in the organic remains of this limestone are the apparent absence of foraminifera, and, with the exception of a minute turbinated shell here and there, its almost entire composition of branches of minute corals, few of which exceed $\frac{1}{17}$ of an inch in diameter.

Jacquemont, who visited Mandoo, has also noticed this rock, and states that he could not find out the quarries from which it came ; but the following passage from Captain Dangerfield's geological description will, I think, supply the deficiency :—

"Passing from Malwa to Guzerat, to the SW., the first well-marked descent occurs near Tirrella, and continues gradually for 14 miles to Para. In the greater part of this distance occur the trap rocks of Malwa, succeeded by coarse sandstones and limestones, with immense quartz beds, siliceous grit-stone, and coarse conglomerates. The limestone is, in general, coarse, approaching in parts to earthy, of a deep brick-red, intermixed with white, and containing often much silex."

This limestone, which is identical in description with that of Mandoo, has a very limited extent in his geological map, where he designates it "coarse granular," and seems to exist in two small strips on the sandstone close to Baugh, and to the same extent on the fine or compact limestone near Sadree. The former is about 32 miles west of Mandoo, and the latter about 30 miles west of Neemuch.

It is at Baugh, then, that the quarries of this limestone appear to exist, and as it seems more connected with the Oolitic Series than any other formation, I place its description here for the present, merely adding that I think it deserving of further examimation, on account of its peculiarities, and the probability of its yielding fossils which might determine its geological age.

### Diamond Conglomerate.

Connected with the Oolitic Series would appear to be the conglomerate which contains the diamonds of India, usually called the "Diamond Breccia," but why it should have been termed breccia I am at a loss to conceive. Franklin and Newbold comment on this, and both would call it a conglomerate. Heyne also calls it a "conglomerate."

A breccia is formed by a subterranean succussion or shock, which reduces more or less of the formation over which its influence extends to a fragmentary state, and these fragments are either retained *in situ*, and reconsolidated by a crystalline cement derived from the parent rock, or only carried to short distances, before they are united together by some foreign material. The fragments of a breccia are therefore necessarily *angular*, and this is its characteristic feature.

A conglomerate, on the other hand, is composed of such fragments after they have been rolled for some distance, or of the harder portions of disintegrated rocks which have undergone similar transportation,

and therefore have become more or less *round:* this is the characteristic feature of a conglomerate.

There is, therefore, a wide difference between the history of an angular portion of a rock, and that of a round one or pebble: the former can never have quitted far, the rock to which it originally belonged; the latter may have travelled hundreds of miles. Thus it may fall from its parent rock into the bed of a river, be rolled and rounded in its passage thence to the sea: there it may undergo a further attrition, and be buried in some beach. After a lapse of time, by the changes of level in the land, it may be situated in the middle of a continent, and the stratum in which it was last deposited having been fractured and raised above the common level of the country, it may again fall into another river; and so on, may be transported from place to place for ages, or so long as its integrity exists.

Hence it also follows, that during the migration of the pebble, it may be thrown into company with others from various formations besides its own, all of which may be widely separated, and once or more in its travels it may be imbedded with the angular fragments of a rock which has been shattered close to the place of its last deposit.

This appears to be the nature of the Diamond Conglomerate of India, which contains pebbles of quartz, jasper, lydian stone, epidote, micaceous iron ore, garnets, corundum, &c., varying according to the locality, mixed with semi-rounded and angular fragments of sandstone and shale, imbedded in quartz sand, which has become more or less consolidated; the former being the hardest parts probably of the Older Metamorphic Strata and Plutonic Rocks, which must have been brought from a great distance, or have undergone long attrition in some way or other to have attained their present roundness; and the latter, probably *debris* of the Oolitic Series, which, from their subangular and fragmental forms, indicate a much nearer origin. In the midst of this heterogeneous deposit, to which the term of conglomerate is certainly more applicable than breccia, the diamonds are scattered, and the whole spread over a great part of India in the way which will hereafter be mentioned.

The following table will afford the best sections of the deposits in company with this conglomerate that have been published. They have been compiled from Voysey's description of the diamond mines at Banaganpilly, a village in Southern India, about 12 miles west of Nundiala, and about 30 S by E. of Kurnool; and from Franklin and Jacquemont's descriptions of the diamond mines at Punna, in Bundelkhund, both of which would appear to have been taken very carefully:—

*Sections from the Surface to the Diamond Conglomerate inclusively.*

| BANAGANPILLY (Voysey). | PUNNA (Franklin). | PUNNA (Jacquemont). |
|---|---|---|
| Feet. | Feet. | Millim. |
| | Soil, Red gravel ..... 2 | Blocks of neighbouring sandstone. Soil. Red gravel. Blocks of neighbouring sandstone, and portions of red, blue, and green shales, in red argil ..... 0-3 |
| Sandstone, clay state, and slaty limestone.. 50 | Shale, argillaceous; calcareous slates and sandstone of red, blue, and green colours, interlaminated ..... 12 | Shale, red, green, and blue ..... Shale, green, speckled lilac ..... Shale, red, green, and blue ..... 3-5 Fine-grained sandstone of a green colour. 0-3 |
| Pebbles.—Puddingstone; quartz; hornstone in argillo-calcareous, siliceous sand. Breccia.—Red and yellow jasper; quartz, calcedony and hornstone of various colours, in quartz sand; diamonds..... 2 | Pebbles.—Quartz, white and green; jasper; hornstone; lydian stone; portions of argillaceous schiste in white quartz; sand, sometimes ferruginous; diamonds. | Pebbles.—Red jasper; lydian stone; milk quartz; white angular fragments of green and ferruginous sandstone; hyaline quartz; semi-rounded portions of micaceous shale, red, white, and green, in adamantine green quartz sand; diamonds ..... 0-3 to 1-6 |
| | Compact sandstone..... 400 | |

From these sections it will be observed, that there is a distinct series of deposits overlying the Punna Sandstone. Franklin states that the rocky matrix of the diamond rests on 400 feet of Sandstone, beneath which there are "strong indications of coal," and that the rocky matrix is superposed by 12 feet of argillaceous shale, calcareous slates with dendritic markings and sandstone. Jacquemont confirms the latter part, with the exception of the "calcareous slates, &c."; but gives a minute description of the composition of the strata, in which he states that there are *angular pieces of sandstone and shale* among the rounded pebbles of the diamond conglomerate.

In Southern India this little series would appear to be somewhat thicker, for Voysey states, that at one part he saw the "sandstone breccia" (diamond conglomerate) under 50 feet of "sandstone, clay slate, and slaty limestone"; while Dr. Heyne, according to Franklin, observes, that "the diamond bed is of the same nature with the rocks both above and below it; but is distinguished from them by its superior hardness, and that the floor is so hard that it strikes fire with steel," a peculiarity which Franklin states equally applies to the Punna mines; and therefore the latter was of opinion that the diamond bed about Banaganpilly, to which Dr. Heyne referred, rested on sandstone. This, however, is not so evident as desirable.

But Newbold, in his description of the diamond mines of Banaganpilly, gives a section of the diamond conglomerate, (which he states is interstratified with "highly crystalline ferruginous sandstone,") resting on dark blue limestone; and further states in his "Summary," that "fossil chert from the limestone is often found imbedded in the diamond breccias of Banaganpilly, &c." Also that "the pebbles from the limestone rocks are both rounded and angular," and that the diamond "conglomerate usually rests on limestone," in Southern India.

This is more conclusive with reference to its formation subsequent to the Oolitic Series than Dr. Heyne's observations, for two reasons, 1*st*, because it is more definite, and 2*nd*, because it brings two deposits together of totally different natures, one of which, viz. the limestone, we now know must not only have been denuded, but broken up, before the other could have been formed.

It would appear from the texture of the Punna Sandstone and the Kattra Shales, that for ages previous to the deposit of the diamond conglomerate, the currents of the water in which they were found must have been very light, and the material spread about by them very subtle; and, therefore, that both must have been suddenly changed when the diamond conglomerate began to be deposited, if not

suspended altogether for a time, as the denudation of the limestone would seem to indicate.

The presence of angular portions of sandstone, and fragments of shales in the diamond conglomerate of Punna, with those of chert from the limestone at Banaganpilly, also supports this view.

All these observations tend to the conclusion that the diamond conglomerate is partly formed from the materials of, and therefore subsequently to the Oolitic Series, yet Voysey has stated that "the matrix of the diamond in Southern India is the sandstone breccia of the "clay slate formation," and his clay slate formation consists of the Punna Sandstone and Kattra Shales. It is possible that he may be right, but at the same time it is evident that the subject requires further investigation.

I should not omit to mention another diamond matrix which has been described by Franklin in Bundlekhund: it lies in crevices of the sandstone, or on the shales, and consists of a conglomerate of jasper, lydian, quartz, and more recent white sandstone pebbles, together with quartz sand, in a soft, plastic, yellow clay. In this are none of the green quartz pebbles, which indicate the presence of the best diamonds; and it is immediately covered by white quartz gravel, and then the red ferruginous gravel of the neighbourhood.

Among the pebbles from the metamorphic rocks in the diamond conglomerate of Southern India, Malcolmson mentions micaceous iron-ore and corundum.

Lastly, in confirmation of the view above taken, of the existence of a conglomerate on the Punna Sandstone, and that conglomerate formed of *debris* of the Oolitic Series, would appear to be the following extract from the letter which Dr. Bell, of the Nizam's Service, kindly wrote me regarding the strata passed through in boring at Kotah. He states:—

"I observe in your section that you have omitted an important layer which exists in the Kotah district, namely the most superficial, which is a conglomerate: it is of no great thickness. Beneath this, we have sandstone, forming hills, varying from 50 to 500 feet in height, resting upon argillaceous limestone, 9 feet;" and then follows the list of the shales already mentioned. He afterwards adds:—"I mentioned the conglomerate bed as important, because in one of its water-worn fragments I discovered a crocodilian fossil, consisting of a mass of dermal scales, with a femur, and some fragments of other bones, upon which Professor Owen came to the conclusion that 'the character of the scales, as well as the length and slenderness of the femur, agree more with

those of the *Teleosaurus* and amphicœlian crocodiles, than with the existing gavials.' This is a most significant fact, as it was picked up 520 feet above the level of the Pranheeta river."

Professor Owen's remarks by no means establish an identity between these crocodilian remains and those of the Oolitic period, though they tend to it. Dr. Bell, in a subsequent communication, informed me that they were found in a fragment of the conglomerate itself, and not in a water-worn fragment contained in the conglomerate.

There can, however, hardly be any doubt, that a conglomerate does exist on the sandstone of the Oolitic deposits, made up partly of their *debris*, whatever may be its age; and that as this conglomerate is sometimes found resting on the limestone of the Kattra Shales, a considerable denudation must have occurred before this could have taken place; also that other rocks, which then presented a naked surface, might have this conglomerate resting on them as well as the members of the Oolitic Series.

Since writing the above, I have had an opportunity of reading Dr. Heyne's "Tracts," who, in his excellent description of the diamond mines of Southern India, states that the diamond conglomerate caps the ranges of hills about Cuddapah, the highest of which is "about 1,000 feet above the level of the country"; that this capping is "between 10 and 20 feet thick"; and that "a similar stony cap" exists "in other parts of India, particularly about Chittledroog and Hurryhur," but that at these places "the hill and cap consist of different kinds of rock, whereas here [at Cuddapah] they are similar."

Of the nature of this capping Dr. H. observes :—"All the different places in which the diamond has been hitherto found consist either in alluvial soil, or in rocks of the latest formation, and containing such a great portion of rounded pebbles as to have rather the appearance of a conglomerate than any other species of stone."

In describing the diamond mines of Ovalumpilly, which are about 6 miles from Cuddapah, Dr. H. states :—"The surface soil is sandy, and 1 foot thick, after which comes 3 feet of red clay; and then the diamond conglomerate." "In the Ellore district the diamond stratum is covered by a thick stratum of calcareous trap." The thickness of the conglomerate differs from 2 to 6 feet, perhaps more in some places.

At Ovalumpilly Dr. H. found in the heaps of stones from the diamond conglomerate which had been examined the following :—pellucid quartz, hornstone, a species of felspar; red, brown, bluish and black jasper; epidote, basaltic pebbles and sandstone; "small globular ironstone," fragments of corundum, and in the

northern diamond mines, viz. at Partel, in the district of Masulipatam, pebbles of colcedony, cornelian, and garnets. (With reference to the origin of the pebbles of epidote, it will be remembered, that I have already alluded to the existence of a beautiful felspathic rock from the Rewa Kanta, composed of epidote and red felspar; from the same district, also, comes a trappean rock, the vesicular cavities of which are filled with epidote alone, or in part with zeolite. On the Southern Coast of Arabia, too, I frequently met with both these rocks, but the epidote was combined with calcareous spar instead of zeolite in the amygdaloid. Epidote appears to be by no means uncommon in the red felspathic rocks throughout India.)

## VI.

### Cretaceous System.

This system appears to have but a feeble representative in India, and to be entirely confined to the southern extremity of the peninsula, where a tract of limestone, containing fossils peculiar to the Lower Cretaceous and Upper Oolitic beds extends, from a point 9 miles inland of Pondicherry to Trichinopoly, a distance of 100 miles, and perhaps still further. This is sub-divided into smaller tracts by upheaval and denudation, as well as by the courses of rivers. It is stated that the fossils of the Pondicherry beds differ from those of the beds near Trichinopoly.

Newbold gives the following description of the limestone near the former:—

"It is usually of a light brownish or grey colour, texture sub-crystalline, graduating into earthy; tough under the hammer, and interstratified with argillaceous and ferruginous beds; of a loose structure, which often abounds with fossil shells. Some parts of the rock are so speckled with a dark-coloured sand as to resemble a *piperino*, though the nature of the sand, whether volcanic or not, cannot be safely pronounced upon. Other varieties are hard and compact enough to bear as fine a polish as many of our mountain limestones. It has been long used for the steps of doors, and in some of the pavements and old fortifications at Pondicherry; the remains of the old quarries are still to be traced, though choked up by rubbish."

It appears to rest on granite, hypogene, and greenstone rocks, unless these have been thrust into it.

Between the Velaur and the Coleroon river Captain Lawford saw fossiliferous linestone beds, divided by a stratum of fossiliferous marl, about 4 feet thick: the lowest beds contained most fossils. At

Garoodamungalum there is a ridge of blue fossiliferous limestone, which extends north and south for 5 miles each way, and at Valconda a calcareous schiste, also magnesite, the latter in loose nodules and masses, imbedded in the soil; hornblende rock also prevails.

The limestone of Trichinopoly is stated to be less crystalline, looser in texture, and darker in colour, than that of Pondicherry.

Of the collection of fossils from these beds which were presented to the Geological Society by Mr. Kaye and the Rev. W. H. Egerton, Professor Forbes, to whom they were submitted for examination and report, states as follows :—

"In the descriptive catalogue accompanying this report, and referring to remains of invertebrate animals in the valuable collection of fossils from Southern India * * * 168 species of Mollusca are enumerated, 156 of which, as far as can be ascertained, are undescribed forms. There are also a number of species of Radiata.

"The results of their examination may be briefly stated as follows :—

"1*st*.—The three deposits, viz. Pondicherry, Verdachellum [about 35 miles SW. of Pondicherry], and Trichinopoly, described by Mr. Kaye, are *Cretaceous*, inasmuch as there are characteristic known Cretaceous fossils in the collections from all of them, whilst no fossils of any other system occur. The nearest allies of the majority of the new species are Cretaceous; and among the genera and sub-genera are many which, as far as we know, are confined to, or have their chief development in the Cretaceous system. The three deposits are connected with each other zoologically by the associations of certain species common to two of them, with others found in the third.

"2*nd*.—Two of the three deposits, viz. Verdachellum and Trichinopoly, are of a different epoch of the Cretaceous era from the third, Pondicherry. The two former have several species in common (and those species among the most prolific in individuals), which are not found in the third. In them we found almost all the species identical with European forms. In several of the genera of which there are many species, the forms are altogether distinct, although, judging from the evidence afforded by mineral character and association of species, the conditions of depth and sea-bottom at the time of the deposition of the strata seem to have been the same. The difference, therefore, must have depended on a representation of species by species *in time*, and not *in depth*.

"3*rd*.—The beds apparently contemporaneous, viz. Trichinopoly and Verdachellum, may be regarded as equivalent to the upper greensand and gault; the European species they include being either

characteristic upper greensand and gault forms, or else such as occur in those strata. The species they contain are either closely allied to known upper greensand or gault species, or peculiar to the Indian beds.

"*4th.*—The Pondicherry deposit may be regarded as belonging to the lowest part of the Cretaceous system. In it almost all the fossils are new: such as are analogous to known species are allied to fossils of the lower greensand of English geologists, and Neocomien of the French. In the genus most developed in this deposit, viz. ammonites, three-fourths of the species belong to those sub-genera especially characteristic of the "Lower Neocomien" of the Mediterranean basin; whilst of the remaining, as many representatives of Oolitic fossils occur as of upper greensand. The resemblance between the ammonites of this part of the collection and those of Castellane, in the south of France, is very remarkable, though the specific identity of any of them is doubtful. Having seen no account of the conchifera of the Castellane beds, I cannot say how far the analogy is borne out among the bivalve Mollusca, among the Indian species of which there are many very peculiar forms."

Of the collection of fishes' teeth made by Messrs. Kaye and Cunliffe in the neighbourhood of Pondicherry, Sir Philip Egerton states as follows:—

"With the exception of two specimens, the collection is entirely composed of teeth of Squaloid fishes. Of these two exceptions, one belongs to the Ganoid order, and to the family of *Pycnodonts*, and is probably a *Sphærodus;* the other is referred to the Cycloid genus *Enchodus*, the teeth very closely resembling those of *Enchodus halocyon*, a species common to the chalk of England, Continental Europe, and North America. Of the Placoid remains, two species only belong to the section of the Squaloid family, with serrated teeth, and both of them are referable to the genus *Corax*, which Agassiz informs us is restricted to the chalk. One species is not distinguishable from *Corax pristodontus*, of the Maestricht beds. The other is undescribed. The Squaloid teeth, with cutting edges, compose the bulk of the collection. They are referable to at least a dozen species, all corresponding, in the absence of plaits or striæ on the surface of the enamel. Although there are close approximations amongst them to the species both of the Cretaceous and Miocene period, yet it is somewhat remarkable that I have not seen a feature nor a character which recalls in the remotest degree the forms of the Eocene period. They belong principally to the *Odontaspid* type; one species being closely allied to, if not identical with the *Odontaspis raphaiodon* of the chalk of Europe. Two or three species are referable to

the genus *Otodus*, one approaching *Otodus appendiculatus;* also from the chalk. Of the genera found in the Pondicherry beds, the following is the stratigraphical distribution assigned by Agassiz. The genera *Lamna*, *Odontaspis*, and *Oxyrhina*, extend from the recent period to the Greensand inclusive, the Jurassic species being now separated from Lamna under the generic title *Sphenodus*, and from Oxyrhina under that of *Meristodon*. *Otodus* extends from the crag to the Greensand, and *Corax* is restricted to the true chalk. The Ganoid genus *Sphærodus* ranges from the Tertiary beds to the Oolite, and the Cycloid *Enchodus* is restricted to the chalk. The distribution of the species is as follows :— *Lamna*, 5 tertiary, 1 cretaceous; *Odontaspis*, 5 tertiary, 4 cretaceous; *Oxyrhina*, 11 tertiary, 2 cretaceous; *Otodus*, 8 tertiary, 5 cretaceous; and *Corax*, 5 cretaceous. Of the five Placoid genera we have 29 species occurring in the super-cretaceous, and 17 in the cretaceous deposits; but not a single species has yet been found anterior to the latter period. The evidence, then, afforded by the Pondicherry fishes, appears to yield strong corroborative testimony to the accuracy of Mr. Forbes' views, derived from the study of the invertebrate remains of the same locality, and I fully coincide with him in assigning these strata to the Cretaceous period. I am, however, inclined—considering the number of species collected, which must be referred to genera which we know decrease in species as they descend in the stratigraphical scale, from the occurrence also of Maestricht species, and from the presence of the genera *Corax* and *Enchodus*, not yet found so low as the Neocomien,—to place this deposit higher in the systems than Mr. Forbes is inclined to do from his investigation."

Both this and Professor Royle's reports on the fossils of these calcareous beds are only considered by their respective authors provisional. The descriptive catalogue mentioned by Professor Royle was not published, but figures and descriptions of the teeth examined by Sir P. Egerton accompany the observations above transcribed.

The following is a list of fossils which were also collected by Messrs. Kaye and Cunliffe, of the Madras Civil Service, from the same beds, and named by Dr. M'Clelland :—

CLASS ANNELIDES.

Fam. SERPULACEA.

*Serpula recta.*

CLASS CONCHIFERA.

Fam. ARCACEA.

*Cucullæa crassatina* (?) Desh.

*Arca Cunliffei.*

—— *crassatina.*

CLASS CONCHIFERA.

Fam. ARCACEA.

*Nucula pectinata.*

Fam. MALLEACEA.

*Inoceramus.*

Fam. OSTRACEA.

*Ostrea trabeculata.*

*Gryphæa.*

CLASS MOLLUSCA.

Fam. CALYPTRACEA.

*Pileopsis plana.*—Same, or allied to shell in coal formation at Cherra.

—— *rotunda.*

Fam. COLIMACEA.

*Bulimus Indicus.*

—— *Pondicerianus.*

Fam. MELANIANA.

*Melaniana* (?) Imperfect.

Fam. PERISTOMATA.

*Paludina.* Allied to *Paludina semicarinata.* Brand. Desh. Coq. Fos. pl. xv. Species of this genus existing in India and elsewhere.

*Obs.*—It is much to be regretted, that the only specimen in the collection is not sufficiently perfect to allow of the species to which it belongs being accurately determined; but the presence of a freshwater shell is important, as tending to show the deposit to have taken place near the mouth of a river, or in a basin alternately subject to salt and fresh water.

Fam. NERITACEA.

*Nerita transversaria.* (Single specimen, imperfect.)

*Natica sulculosa.*

*Nerita speciosa* (?)

Fam. SCALARIANA.

*Scalaria annulata.*

—— *zonata.*

—— *bicostata.*

—— *tricostata.*

—— *Kayeii.*

Fam. TURBINACEA.

*Trochus linearis.*

Fam. CANALIFERA.

*Murex levis.*

Fam. ORTHOCERITA.

*Baculites.* Compressed, tapering, consisting of short joints; margins unequal, both somewhat flattened.

Fam. NAUTILACEA.

*Nautilus.* Three distinct species.

Fam. AMMONACEA.

*Ammonites.*

"Echini, fishes' teeth, and Hamites, corallines of the Turbinalia species, and others of a pyriform shape. There are also shells of the families Myaria, Nymphacea (Astarte), Cardiacea, Mytilacea, Pectinides, Ostracea (resembling Exogyra), Turbinacea (Turritella ?), Canalifera (Pyrula ?), Alatæ (Rostellariæ ?), Purpurifera (Buccinum ?), Convolutæ (Voluta ?), Ammonacea (Orbulites and Criocératites). A number of sulcated cylindrical bodies, not exceeding the thickness of a quill, of different lengths, but generally from 2 to 3 inches long, and in all cases broken off, are scattered in the substance of the rock. They resemble somewhat the spines of echinites. There was also a found vertebra of a fossil, which Professor Owen pronounces to resemble that of Mososaurus."

It should be remembered, that although the limestone beds in the southern extremity of India have all been placed in the cretaceous group, yet that Professor Royle found in the collection of fossils from Pondicherry three-fourths of the ammonites expecially characteristic of the Lower Neocomien; while of the remaining, as many representatives of Oolitic fossils occurred as of upper greensand; and hence, that a part of these beds may belong to the Oolitic Series.

## VII.

### EOCENE FORMATION.

The most southern position in which this formation would appear to exist in India, is in the westernmost spurs of the Rajpeepla hills, which form the left bank of the valley of the Nerbudda, about 50

miles from the sea. It would appear also to exist in Bate island, which is situated at the north-western extremity of Kattyawar; but the presence of more fossils, if not of nummulites, is required, to prove that these are not deposits of the Miocene age. Cutch is the most southern province in India where the existence of nummulites has satisfactorily established that of the Eocene Formation, and here it only exists in a small tract; from which, however, it is probably continued on, under the alluvium of the Indus, to the neighbourhood of Hydrabad, where it again appears to a much larger extent; also extending between Roree and Dajikote, and probably under the alluvium on to Jessulmeer in the Great Desert, if the yellow limestone of this place, which is the same as that chiefly used for tombstones in Lower Scinde, belongs to the Nummulitic Series.

Nothing more is known of this formation at the Rajpeepla hills, or in Bate island, than that we possess several specimens from the former, charged with *Orbitoides Prattii*, which were presented to the museum by Major Fulljames; and specimens from the latter containing nummulitic fossils, which were presented by Lieutenant Taylor, of the Indian Navy. We have also several specimens of limestone from the north-western third of Kattyawar, which seem from their structure to belong to this formation; but this is all that can be stated of them, for they contain no fossils which are recognizable.

The only tract of nummulitic limestone, according to Colonel Grant, which exists in Cutch, is situated in its north-western extremity, near the mouth of the eastern branch of the Indus, where it appears to have dwindled away to a mere remnant, unless it was never very much larger. It extends from Luckput southwards for 30 miles, and its northern, which is its widest part, is 8 miles across. Where small sections of it present themselves, as in the banks of rivers, it consists of solid rock, of a cretaceous appearance, 60 or 70 feet in thickness, filled with *Nummulites*, *Fasciolites*, and *Orbitolites* (*Orbitoides* in the illustrations); in other parts it consists of "nummulitic marl," of the same depth. It is overlaid by loose fossils, and detached portions of its own surface, or by a thin stratum of gravel.

Near the hill called Baboa, the nummulitic marl is cut through by a dyke of "very compact dark green basalt," of which conical masses, capped with the marl, are undergoing spheroidal desquamation and decomposition at the line of contact between the two.

The nummulitic limestone of Scinde, that is to say at Hydrabad, which projects about 60 feet above the level of the alluvial plain, is solid, white, and cretaceous above, where it is richly charged with

*Fasciolites elliptica*, and other nummulitic fossils, and yellow, plastic, and marly below. I failed to discover any nummulites in either portion.

At Sukker, the range of nummulitic hills, which, according to Dr. J. P. Malcolmson, do not exceed 400 feet high, are composed of friable or compact limestone, of a white or cream colour, resting on yellowish white plastic clay; the former richly charged with *Nummulites*, and plentifully interspersed with flints, which also envelope *Nummulites* and *Orbitolites*, that are silicified.

The following section comprises the three last divisions of that deduced by Captain Vicary from an examination of the beds about Kurrachee, and the composition of the Halla range; the other part of the section will be given under the head of "Miocene and Pliocene Formations":—

"Pale arenaceous limestone, with hypponyces, nummulites, and charoideæ.

"Nummulitic limestone of the Halla range.

"Black slates, thickness unknown."

In his detailed descriptions, Captain Vicary almost always particularizes the existence of nummulites in the first division of this part of his section, whereas he uses the word adjectively for the second part, or nummulitic limestone, as if he had not seen nummulites so often in the latter; which, with my own observations on the coast of Arabia, induces me to think that they have not a very great vertical range, and that the limestone which follows them, although containing abundance of *Orbitolites* and *Alveolina*, contains no *Nummulites*; but I am by no means certain of this.

At Muskat, on the coast of Arabia opposite Scinde, there is a very clear section of this series exposed in many places, in the sea-cliff. It consists superiorly of coarse limestone, of a yellowish white colour, from 60 to 100 feet thick; then arenaceous limestone, containing a great many corals; afterwards this passes into sand, with veins of gypsum; and the sand again into beds of pebbles resting on serpentine rock with pinch-beck diallage, or on diorite. In this series, at Muskat, Newbold found a bed of nummulites, which I had not the good fortune to see during my examination.

A similar section is seen in the island of Masira, resting here, also, on diorite and serpentine rocks; but the pebble-bed seems to be replaced by red and dark-coloured clays, which, from their appearance, indicate a conformable transition of the latter into the former.

The arenaceo-calcareous strata in one part of this island abound in nummulites of a similar kind to those which Newbold found at Muskat.

On the mainland of Arabia, opposite the south-western extremity of Masira, is another section of the kind, but here the deposits are more or less white. The limestone, which is about 150 feet thick, rests on a greenish-white clay.

Does this marl or clay, or sandy deposit which underlies the nummulitiferous limestone respectively at Muskat, Masira, on the mainland of Arabia, in Cutch, and in Scinde, limit the vertical extent of the nummulitic beds?

That there are *Orbitolites* and *Alveolina* in great quantities under this, as before stated, the white compact limestone which underlies it on the coast of Arabia, and which appears to average upwards of 1,500 feet in thickness, furnishes abundant evidence, but I never saw any *Nummulites* in it; yet this appears to be the nummulitic limestone which Captain Vicary terms the "backbone of the Hara range," and which he states in one part "abounds with nummulites, &c." It is very desirable that more definite observations should be obtained of the Nummulitic Series, and in no part of the world, perhaps, could this be more satisfactorily accomplished than in Scinde.

I have been always struck with the whiteness, uniform fineness of structure, and great thickness of this limestone, which forms the chief feature of the South-eastern Coast of Arabia; and the few fossils I found in the coloured strata immediately under it on the coast of Arabia so resemble those of the lower greensand or upper oolite, that I cannot help thinking that this white limestone is the analogue of the chalk in these regions.

The following is a list of the fossils obtained by Colonel Grant from the nummulitic formation in Cutch, which been described by Mr. J. de C. Sowerby:—

"*Cardium intermedium.*—This shell, of which we have only casts, is very near in form to *Cardita intermedia* of Lamarck; the hinge, as we learn from the impression, however, wants the long marginal tooth which marks the genus *Cardita*. Length 1 inch, width the same.

"*Cardium ambiguum.*—The furrows upon the surface of this cast are deeper than they would be in a cast from the European *C. serratum*, which, in the general form of the shell, and number of furrows, it resembles more strongly than it does the *C. lævigatum* of the Indian seas. Length 2 inches 1 line, width 1 inch 10 lines.

"*Area hybrida.*—Transversely oblong, oblique, longitudinally costated; costæ strongly marked with the lines of growth, those on the anterior side furrowed along the middle; area narrow. Length 11 lines, width 14 lines.

"Nearly related to the recent *A. rhombea*, but with a narrower area between the beaks, approaching to *A. Indica* of Linnæus.

"*Pectunculus Pecten.*—Orbicular, convex, ribbed; ribs about 30, radiating, crenated by the lines of growth; hinge-line short. Length 10 lines, width 11 lines.

"Very nearly like *P. pectinatus* of Lamarck, but with more numerous and more distinctly granulated rays.

"*Nucula Baboensis.*—Transversely oval, convex, smooth? lunette sunk; beaks nearest the anterior side. Length ⅝ inch, width 1 inch.

"Nearly resembling *N. Bowerbankii*, (Geol. Trans. 2nd series, vol. v. p. 136, pl. 8, f. 11,) but not truncated or pointed below the lunette.

"*Pecten lævi-costatus.*—Short, smooth, radiated; radii about 20, large, equal to the spaces between them; ears large; inside furrowed. Length 1 inch 4 lines.

"Length a little less than the width, but the ears enter so much into the sides that they confine the beaks into a small angle, and make the form appear more transverse than it really is.

"*Ostrea callifera?* (Lam. Hist. Nat. vol. vi. p. 218; Deshayes, Coq. Fossiles des Env. de Paris, vol. i. p. 339, pl. li. f. 1, 2.)—A very ponderous shell, with only a shallow cavity for the animal. Length 3½ inches, width 2¾ inches, thickness of the shell above an inch and a quarter.

"*Ostrea orbicularis.*—Orbicular, plaited; both valves convex; plaits angular, repeatedly forked; surface imbricated. Length and width about 2 inches. Resembling *O. Flabellulum*, but more regularly and finely striated.

"Loc. Luckput.

"*Neritina grandis.*—Short, conical, smooth; spire concealed; aperture very large; base convex, its margin rounded. Diameter 3 inches, height 1½ inch.

"This resembles *N. Schmidelliana*, but has a larger aperture in proportion, and a less excentric apex; it is also higher. The specimen is little more than a cast, and does not exhibit the edge of the inner lip, but still it shows the attachment of the ligament projecting from the lower surface, and that the aperture occupied more than half the base.

"*Globulus obtusus.*—Globose, with a very short spire; whorls about 6; aperture ovate, elongated, pointed above; umbilicus open, narrow. Height 1 inch, diameter the same.

"The short spire of 5 whorls gives this shell a very blunt aspect.

"*Turbinellus bulbiformis.*—Short, fusiform, smooth; spire pointed; whorls 6, flattened in the middle; aperture narrow, pointed at both ends. Height above 7 inches, diameter 5 inches.

"Resembles *T. Napus*, but has a more elongated spire.

"*Cypræa depressa.*—Obovate, with a blunt spire, and a flattened space across the middle of the back. Length 3½ inches, width 2 inches 7 lines.

"This being only a cast, we can give but a very imperfect description.

"*Nummularia acuta.*—Depressed; sides conical, decreasing in proportional height by age; when young radiated, when full grown granulated; volutions and septa numerous; edge sharp. Diameter 5 lines, thickness 1½ line.

"Distinguished from most other species of *Nummularia* by the conical form of the sides.

" *Nummularia obtusa.*—Irregularly orbicular, thick, smooth ; sides flattened ; margin rounded ; volutions and septa very numerous. Diameter of the largest individual 10 lines, thickness nearly 5 lines. A remarkably thick species.

" *Lycophris Ephippium.*—Orbicular, depressed, curved so as to resemble a saddle, with a gentle elevated umbo on each side ; margin thick, obtuse, with a narrow waved keel in the middle ; grains on the surface small and equal. Diameter 1½ inch, thickness 3 lines.

" *Lycophris dispansus.*—Lenticular, thick, very thin, expanded, sharp-edged margin ; grains on the surface largest in the centre of the disk. Diameter ½ inch.

" These two fossils may possibly be different stages of growth of the same species ; for there occur along with them many curved plates, which are intermediate in form.

" The grains on the surface are the projecting extremities of internal columns, not merely granulations in the substance of the fossil, as in some species of *Nummularia*. The internal structure is totally different from that of *Nummularia*, as it is only on the inner surfaces of the two plates that any appearance of a spiral or concentric series of cells can be traced. In p. 300 these fossils are assigned to the genus *Orbitolites*.

" *Fasciolites* (Parkinson) *elliptica.*—Elliptical, with blunt extremities, bands curved. Length 5½ lines, diameter 3 lines.

" Several species of this genus occur in the tertiary formations of Europe, but they are longer in proportion to their thickness.

" *Echinus dubius.*—Orbicular, depressed ; areæ granulated, concave, and nearly free from grains along the middle ; the larger furnished with two rows of tubercles near each side ; the lesser with one row on each side ; pores of the ambulacra in numerous arched rows. Diameter about 3 inches, height about 1¼ inch.

" This has apparently imperfect tubercles, and is much longer than *Cidarites variolaris* (Brongniart), which, however, it much resembles.

" *Galerites pulvinatus.*—Orbicular, depressed, spheroidal, covered, with minute tubercles. Ambulacra, obscure beneath, crossed by grooves above. Diameter 3¼ inches, height 1 inch 10 lines.

" A species much like *G. depressus* (Lamarck), but more convex, and ten times the size of it.

" *Clypeaster affinis?* (Goldfuss, p. 134, t. 43, f. 6.)—Our specimen appears to be more orbicular than the *C. affinis* of Goldfuss, but it is too imperfect to be determined, the posterior half being nearly all broken away. Length about 2¼ inches, width 2 inches, height 1 inch.

" *Clypeaster varians.*—More or less obovate, hemispherical ; base slightly concave in the middle ; ambulacra elongated ; anus transverse. Length 2½ to 3 inches, breadth 2 to 2½ inches, height 1⅞ to 2 inches.

" *C. Bonei* of Munster (Goldfuss, 131, t. 41, f. 7,) resembles this, but is more depressed, and has a circular anus.

" *Spatangus obliquatus.*—Gibbose ; emarginate at the front ; behind obovate, rather accuminated, and truncated obliquely upwards. Ambulacra deeply sunk in 3 large and 2 smaller ovate pits ; base slightly convex. Length 2½ inches, width 2 inches, height 1½ inch.

" Strongly resembling *S. Bucklandii* (Goldfuss, 154, t. 47, f. 4). It is, however, much larger, and has unequal ambulacra. In this and the allied species,

with concave ambulacra, there is a reticulated band surrounding the ambulacra, which deserves attention.

" 23 *a. Spatangus accuminatus*? (Goldfuss, 158, t. 49, f. 2.)—Our specimen is not quite so much elevated posteriorly as the figure given by Goldfuss, neither is it quite so wide; in both these circumstances it approaches to *S. lacunosus;* but it is laterally crushed, which may account for the difference. Length 1¼ inch, width nearly the same, height 10 lines.

" *Spatangus elongatus.*—Elongated, ovate, depressed; front emarginate; base convex: ambulacra concave, with two of the rows of pores nearly central; apex excentric; mouth remote from the margin. Length nearly 2½ inches, width 1⅞ inch, height 1 inch.

" The two posterior ambulacra and the posterior portion of the shell are broken; the description is therefore incomplete."

*Localities.*—All these fossils were found at " Baboa hill" or " Wagé-ké-pudda."

So far, my observation of the fossils which have come from the nummulitic formation in Scinde, leads me to the opinion that they chiefly differ in specific characters, from those of the Paris Basin which have been figured by Deshayes, and that very few new genera will be found among them. Some of the limestone at Hydrabad is remarkably like the " Calcaire grossier."

Although the fossils are abundant almost beyond conception, yet they are mostly useless for description, on account of being the internal casts, and not the petrified remains of the shells they represent.

There appear to be only two species of *Nautilus:* at least out of 180 specimens collected from all parts, I have only met with that number, viz. 150 of one and 30 of the other. The largest is the scarcest.

As they do not appear to have met with descriptions, the following may prove acceptable:—

*Nautilus major.*—(H. J. C.) (Cast.)—Sub-orbicular, discoidal, compressed; margin angular; widely umbilicated; sutures undulous, doubly sigmoid; siphon ventral. *Size.*—Longest diameter of largest specimens 12 inches; largest transverse diameter upwards of 6½ inches.

*Obs.*—This species, from its angular margin, resembles, in form, the sub-genus *Goniatites* among the *Ammonites.* In the position of its siphon, it agrees with *Nautilus zigzag,* but its sutures are simple, like those of *N. Danicus.* I have never seen a specimen of *N. zigzag* from Scinde, though we have one in the museum which Professor Orlebar brought from the Eocene of Egypt. *N. major* must, I think, be the largest nautilus on record.

*N. minor.*—(H. J. C.) (Cast.)—Sub-globular; margin round; umbilicated; sutures sub-sigmoid; siphon ventral. *Size.*—Longest diameter 3 inches; largest transverse diameter upwards of 2½ inches.

*Obs.*—This species agrees with *N. hexagonus* in the position of the siphon and form of the suture; but it differs from it in not having a sulcated keel or margin.

Descriptions of most of the largest forms of fossilized Foraminifera in Scinde will be found in the last number of this Journal.

As yet we know nothing definite of the nummulitic formation of this country, although its features are so striking, that the most disinclined for observation or the study of natural objects come away from Scinde astonished at the geological sections of its rocks, and the vast quantity of organic remains which are distributed over them.

## VIII.

### Volcanic Rocks.

Trappean System, 1st Series.. { *Trappite.* *Basalt.* *Amygdaloid.* *Laterite.*

Subsequent to the deposit of the Punna Sandstone, or the last bed of the Oolitic Series, in the interior of India, a succession of trappean effusions took place.

These were more profuse in some than in other parts, and, generally, more extensive, as the existing tracts and weathered blocks which are scattered over many plains respectively testify. The trappean dykes, too, which exist throughout the greater part of India, from the summit of the highest mountains (Neilgherries) to the level of the sea, and the crystalline metamorphosed state of the upper part of the Punna Sandstone in many places,—apparently from heat applied to the surface,—all tend to the inference that the trappean effusions extended over a much greater part of India formerly than at the present day.

The largest tract remaining is that on the western side of India, but sufficient time has elapsed since the last of *its* effusions were poured forth to weather down its cones, efface its craters, dissipate its scoriæ, break up its plains, and transform its surface to such an extent, that from an arid, black, undulating volcanic waste, it has now become a tract of mountains, hills, and valleys, covered with verdure and cultivation; and, with the exception of the crater of Loonar, without a known trace of any vents, to point out the localities from which the volcanic matter of which it is composed was ejected.

This tract, called by Malcolmson the "Great Basaltic District of India," extends continuously from the western side of the basin of the Malpurba, in the Southern Mahratta Country (P.MS. Aytoun), to Neemuch, on the extreme morthern limit of Malwa (Dangerfield); and transversely from Balsar, on the coast about 20 miles south of the Taptee (Lush), to Nagpore in Central India (Malcolmson). These

are its extremes north and south, and east and west; the former a distance of about 535, and the latter one of 350 miles. Between Balsar on the west and Nagpore on the east, it contracts northward to a width of only 80 or 90 miles, where the Nerbudda crosses it between Chiculdah and Burway (to mention the large towns close to its limits). After this it again expands out to form the tract of Malwa, which extends eastwards to Tendukaira, about 70 miles west of Jubbulpore, and westwards to Tandla (Dangerfield). From Nagpore south-westward to Beejapore it is bounded, as in Malwa, by an irregular and more or less abrupt border; and its coast-limits are Balsar in the north and Malwa in the south.

There is another portion, which extends eastward from Jubbulpore to Amerkuntak, the source of the Nerbudda (Spilsbury), and south-west towards Nagpore (Franklin); but I am ignorant if this joins the main tract.

As there is necessarily a great sameness in the trappean effusions throughout India, wherever they exist to any extent, we shall take our typical characters from the great district just described; and even here, a part would seem to suffice for the whole, for the remarks of Dangerfield on it in Malwa, of Coulthard in the adjoining district of Saugor, and of Sykes, Malcolmson, and Newbold in the Deccan, are but repetitions of each other.

Its two grand geological features along the anticlinal axis of the Western Ghauts, where it has attained the highest elevation, are flat summits and stratification. The latter arises from the alternation of compact and amygdaloid layers, which, on weathering, give to its lateral outlines that irregular step-like form, from which the trappean effusions have derived their name. Captain Dangerfield numbers "14 beds" in Malwa, the lowest and largest of which is 300 feet in thickness. These are equally numerous, if not more so, along the Western Ghauts, where the scarps are of much greater magnitude: that of the pass of Ahopeh is, according to Colonel Sykes, "fully 1,500 feet high, and that of Hurrichunderghur, about 20 miles north of it, scarcely less than double that height." The mountain of Mahableshwur is from 4,500 to 4,700 feet above the level of the sea. From these summits the trappean district slopes off suddenly on each side, but more abruptly towards the west, where it reaches the level of the sea within 40 or 50 miles of the anticlinal axis.

Besides its stratification, it presents in many places, on closer inspection, a columnar structure, which is chiefly confined to its compact beds, and which seems to have been more frequently noticed on the

summits of mountains, and in the beds of valleys and watercourses, than in any other part. Thus Colonel Sykes mentions a surface of pentagonal divisions in the hill-fort of Singhur, which is 4,162 feet above the level of the sea; also in the hill-fort of Hurrichunderghur, just mentioned; while Captain Dangerfield mentions them in the bed of the Chumbul and Nerbudda rivers. They are common on the surface of the overlying trap of Bombay, but with the lower part so continuous and so stratified, that, like that described by Newbold in the bed of the Hurri, near Beejapore, its divisions into "rectangular and rhomboidal prisms are similar to those of clay slate." Voysey has noticed its columnar form in the upper part of the hill of Sitabaldi, which is close to Nagpore, and Malcolmson on the elevated lands and crests of the Sichel Hills. Many other places might be mentioned where this structure occurs in like situations, but very few where it has been seen in the body of the mountains.

Wherever the trappean effusions exist to any extent, they appear to be composed of the rocks mentioned at the beginning of this group, viz. *Laterite* above, then *Basalt*, and afterwards *Trappite* and *Amygdaloid*, with here and there volcanic breccia. Where the trappean rocks are genuine, that is where they are neither mixed with foreign matter nor decomposed, they are chiefly compounded of hornblende and felspar, but differ from the diorites or greenstones, as before mentioned, in the former being finer in structure, less crystalline, and generally containing a portion of greenish, bluish, or reddish earth, according to the colour of the rock, in addition to their crystals of hornblende and felspar. The latter is never the case with diorite, and is, therefore, perhaps, the best distinguishing feature, but it can only be detected by a powerful lens. The diorites appear to have gained their coarseness of structure and more crystalline nature chiefly from the length of time they have been exposed to the percolation of water, while they have been totally excluded from the atmosphere. There are, however, fine black, red, and green, coarse crystalline hornblendes, here and there, among the trappean rocks, which in hand-specimens, would almost defy the best judges to say whether they are not diorities or amphibolites, but they are only of casual occurrence.

Before proceeding to particular descriptions of these rocks, it would be as well to devote a few moments to the consideration of the facts which bear upon the relative ages and positions of the trappean effusions. It should be remembered that there is this great difference between the supperposition of aqueous and igneous formations, viz. that the former must have been increased in thickness by successive

additions to their surface, and that the latter may be increased in thickness by additions also below their surface; the material in the one case coming from above, and the material in the other from below. Hence circumstances may so favour a horizontal extension, and oppose a vertical ascent of the latter, that it will be found in some places intercalating the interior of volcanic mountains which have been formed long anterior to its ejection. At the same time, this intercalation must have taken place before the whole tract was broken up, or the circumstances favouring it would not have been present. It is not our object here to enter into the theory of the elevation of the Western Ghauts, or of any other parts of the trappean district, but to try to acquire some idea, if possible, in the present state of our knowledge, of the relative ages of the effusions of which it is composed. One fact seems evident, viz. that there is an overlying basalt, which, generally capped with laterite, rests on the summits of the highest mountains, and on the tops of the lowest hills; and that the former are separated from each other by such wide and such deep valleys, that they never could have been capped with the same material, had they not all been united into one mass when the basalt and laterite were poured forth. The trappean effusions, then, had probably attained their greatest thickness along the anticlinal axis of elevation, that is along a line a little to seaward of the Western Ghauts, before this took place, for here the mountains being highest, and most separated, exhibit a thickness of trappean rocks far greater than in any other part; which tends to these inferences, viz. that in this direction there was a line of vents; that the greatest and latest effusions from them preceding the elevation of the Ghauts, made the trappean rocks thicker here than in other part; and that along this line of vents the subterranean force which elevated the Western Ghauts was most likely to be exerted. But it does not follow that the overlying basalt was the last effusion, for the intercalation of subsequent ones may have added, as I have before stated, considerably to the thickness of the general mass, before the grand disturbance occurred which threw the whole up into mountains; while there is evidence, as we shall see hereafter, of many minor effusions having occurred since this epoch.

With these few prefatory remarks, let us proceed to the description of the trappean rocks separately.

### *Trappite.*

This rock is semi-crystalline, and consists of felspar and hornblende in nearly equal proportions, with a little argillaceous matter. Its

structure is massive, and its texture visible only under a high magnifying glass, when the ingredients of which it is composed also become recognizable. It is tough towards the surface, and softer below, where it breaks with a granular earthy fracture, sometimes conchoidal. It is of a black, red, bluish, or greenish-blue colour; is easily scratched with a knife; disintegrates in polyhedral masses, undergoing concentric-lamellar decomposition, and finally passing into a greyish or greenish brown earthy mass, which has been called wacken.

The reader will do well to remember, that wherever "wacke" or "wacken" is here mentioned, it means decomposing or decomposed trappean rocks. The name "Trappite" is taken from Brongniart's classification, to which I have already alluded, but it contains no mica.

*Basalt.*

There are two kinds of this rock which deserve particular mention: one is for the most part of a dark blue-black, and the other of a brown-black colour. Both are semi-crystalline, like the last rock, and composed of felspar and hornblende, or augite, with probably a little amorphous, argillaceous matter. Their structure is massive, stratified, columnar, or prismatoidal; and they are tough, and tesselated towards the surface, but frangible below. They disintegrate in polyhedral masses, which undergo infinite divisions, and, desquamating in concentric laminæ, assume the form of a bed of rounded nodules of various sizes, and of a greenish-brown colour, becoming smaller and more numerous as they pass into an earthy wacken, in which all traces of the hard rock disappear.

*a.* Dark blue-black basalt of the island of Bombay. This is so compact that its ingredients cannot be distinguished, even with a lens. Its structure is remarkably stratified, almost like clay slate; it breaks with a sub-granular, conchoidal fracture; is avesicular, but contains here and there a small mass of pale crystalline olivine.

*b.* The brown-black basalt of the Deccan. This is sub-granular, and the ingredients of which it is composed more or less visible; it is tough, and breaks with a sub-granular fracture; is avesicular, but presents many scattered masses of olivine; it is of the same kind as the basalt of the "Pouce," in the Mauritius. Sometimes the olivine seems to pass into glassy felspar, and then to form a great part of the rock.

That the first kind belongs to the overlying basalt, there can be no doubt; and from Voysey's having likened the overlying basalt of the Gwailgurh hills to that of the "*Pouce*" mountain, in the Mauritius, there can be little doubt, also, that the second form is also to be found

in the overlying basalt. At the same time, it would be very desirable, as will hereafter appear, to ascertain if the different forms of the overlying basalt possess any peculiarities which distinguish them as a group from the other trappean effusions.

Both the *Trappite* and *Basalt* are tesselated on the surface by cracks and veins, which would seem always to be present throughout their structure, though not always visible; those of the basalt tend most to a prismatoid arrangement. Both, too, even in their massive forms, present accessory minerals here and there: in the basalt these consist chiefly of small masses of olivine, and in the trappite chiefly of zeolites. The position and depth of the basalt appears to be overlying and thin, and that of the trappite for the most part inferior and thick; the structure of the former more or less prismatoidal, that of the latter more or less irregular. Occasionally the texture of these rocks is a little finer or a little coarser, a little more crystalline or a little more earthy.

*Amygdaloid.*

This is only a variety of one or the other of the foregoing rocks, but it is convenient to give it a specific name. With more or less of their characters, though never strongly marked, it is also more or less cavernous or vesicular, and the minerals which fill or line its cavities very various, while some appear to be peculiar to a trappitic, others to a basaltic base. Green earth, zeolites, calcspar, and calcedony or quartz appear to prevail in the former, and olivine, glassy felspar, and magnesia-mica in the latter. To each of these minerals we shall now turn our attention separately, as, upon the prevalence of one or the other depends greatly the character of the amygdaloid; and those found in a trappific or earthy base being most numerous, we will take them first.

Minerals of the Trappean Rocks.

*Green-Earth.*—There is no mineral in the amygdaloids which is more general or more striking at first sight than this, from its bright blue green colour, and its frequent occurrence. It prevails chiefly in the red amygdaloids, lining their cavities, or mixed with the minerals which they contain, but never entering into a part of the composition of the latter. Nicol places it among the clays. It appears to be amorphous, is greasy to the touch, sectile, and presents a shining streak when scratched with a smooth pointed instrument. Its colour is apt to mislead those unacquainted with its elementary composition, into thinking it contains copper, but iron and manganese are the only metals which have been found in it.

*Zeolites.*—Next in prevalence are the following minerals of the zeolitic family, which is, perhaps, as well, if not better represented in India than in any other part of the world :—

*Scolezite*, is probably the largest and most plentiful of these, occurring in compact or crystalline, columnar, radiating masses, white, or of a pinkish tinge, opaque or translucent, and in small crystals transparent ; in some specimens the radii are from two to three inches in length. *Natrolite* or *Mesotype*, in mammillary masses of fine prismatic or acicular crystals, sometimes asbestiform ; it occurs at Akulpore, in the Southern Mahratta Country, in radiating columnar masses, extending six or seven inches from the centre (Sykes). *Apophylite*, in thick rectangular prisms, with truncated or pointed summits, is very common ; opaque or translucent ; when the summit is perfect the latter is generally transparent ; cleavage across the prism (macrodiagonal), leaving a pearly surface ; it also occurs foliated and massive. *Stilbite*, in compressed rectangular prisms, terminated by four narrow facets, is also very common, occurring in radiated, fan, sheaf-shaped or scopiform aggregates on free surfaces ; semi-transparent, like crystallized spermaceti ; also occurring in radiated masses of a white or pinkish colour, like scolezite, but with a laminar-columnar arrangement ; cleavage longitudinal, parallel with the compressed planes, leaving a pearly surface ; perfect crystals rare with the aggregates ; occurs frequently on apophylite in geodes. *Heulandite*, in compressed lozenge-shaped crystals, aggregated, and standing on their edges, with the upper angle replaced more or less by a facet on each side, and the free terminal one generally truncated. *Chabasite*, in very obtuse rhombohedrons, scarcely differing from a cube ; glassy, pearly, greyish, yellowish, reddish. *Phrenite*, of a sea-green colour, is not uncommon, crystallized on zeolites in rounded aggregates.

From the pearly cleavage of most of these minerals, it is difficult to say which is which in their amorphous masses, or when they fill the vesicular cavities of the amygdaloid.

*Laumonite*, appears to be the commonest zeolite in the neighbourhood of Bombay, occurring in oblique rhombic prisms, of which the inclination of the terminal plane is from one acute angle to the other, one of those angles being replaced by a facet. It is translucent when first exposed, but becomes opaque, white, and brittle in a short time afterwards ; this renders it easy of recognition.

*Quartz.*—Almost all the varieties of this family occur in the trappean rocks, but chiefly in large crystals in geodes, colourless or amethystine ; also in small crystals forming stalactitic, finger-like

prolongations, and capping large pyramidal crystals of calcspar in geodes. Calcedonies, agates and onyx which also abound, belong to this family.

*Calcspar.*—This occurs in rhomboidal masses, and in pyramidal crystals projecting into the interior of geodes. The latter seems to have been a very early crystallization, which has not only been succeeded by the capping of quartz just mentioned, but this capping itself is in most instances more or less hollow, from the re-absorption of the calcspar. The pyramidal form of calcspar had a great development at one time, for its crystals, now only represented by the quartz, far exceed in size those of any other trappean mineral. The rhombohedral masses are of three kinds, viz. colourless, hair-brown and green; the latter is found in portions of 2 feet in diameter, in amygdaloid forming the bed of a river near Gorgaum, north of Akulkote, in the Southern Mahratta Country (Newbold); also in the Buktapore hills near Kowlas, about 30 miles NNE. of Beedur (Voysey); and Grant mentions "thin beds or layers" of leek-green calcspar in an amygdaloid in Cutch. Besides these, various other forms of calcspar occur, but the ones mentioned are the most prevalent. Perfect crystals of both pyramidal and rhombohedral calcspar resting on zeolitic minerals are not uncommon in geodetic cavities.

*Olivine.*—This mineral, as I have before stated, is almost peculiar to the basalt, and is but sparingly scattered in the overlying portion. It, however, frequently forms part of an amygdaloid, with a black compact base, and, when mixed with *Rubellan*, seems to depart from its original faint colour to become of a greenish yellow, pistachio-green, brass or bronze yellow, brown, pitch black, or brown-red tint.

*Glassy Felspar.*—A porphyritic amygdaloid with a similar base to the foregoing, and thickly charged with tabular crystals of this mineral, is very common, the crystals having a vitreous lustre, and a faint yellow colour; but, when they occur in a reddish base, they have a whitish colour and pearly lustre.

The black porphyritic form exists in a thick stratum on the summits of Hurrichunderghur and Poorundhur, which are 4,000 feet above the level of the sea; also in the bed of the river Goreh, which is elevated 1,000 feet above it, near Seroor (Sykes). Dangerfield also states that at Cherole and Kuchrode, in Malwa, there "are some large overlying masses of trap porphyry," which is probably the same as the one described; and in the Society's museum are specimens from Khandeish (Aytoun), the neighbourhood of Poona (Malcolmson), and Belgaum (Aytoun). Olivine occasionally appears to pass into glassy felspar,

and then the latter, as I have before stated, increasing in quantity, to form, in an amorphous crystalline state, a large portion of the elementary composition of the basaltic rock.

*Magnesia Mica.*—Accompanying the glassy felspar are small laminated masses of a substance like mica, which are either separate, or in the midst of the tabular crystals of felspar. Its chief characters are its scaly, foliated, laminar form, rich brown-red colour, shining lustre, and softness, being easily scratched with a knife; but in its fracture it is less flexible than mica, if, indeed, it have any flexibility at all.

Besides this form, it appears to occur in a massive crystalline, transparent or opaque state, partially or wholly filling small vesicular cavities, and presenting a bloom on its free surface. When translucent, it is of a hyacynth-red, peach-blossom, or red-brown colour, and when opaque of a blood-red, dark brown-red, dark olive, or pitch-black colour like obsidian, to which it seems nearly allied. In the latter state it may also form a continuous scaly layer on the free surface of the basaltic rock.

It frequently coats the surface of the tabular crystals of felspar and olivine, and on the other hand lines vesicular cavities, like green-earth, to which in these instances it also appears to be closely allied.

When the tabular aggregates of this mineral loose their lustre, they assume the form of *Rubellan*; when it has a strong metallic lustre, it looks like *Rutile*. In another form, which I have not mentioned, it has a waxy appearance, and greenish yellow colour, like serpentine. Its colouring matter appears to be chiefly iron, which in the metallic varieties is easily detected by the blow-pipe and magnet. Sometimes this magnesia mica or *Rubellan* seems, in minute crystallization, to form the greater part of the base of the red amygdaloids, and on decomposing assumes the form and appearance of red clay. If the *Rubellan* of Breithaupt be magnesia mica, as Nicol seems to think, then this mineral is magnesia mica; but it requires further examination.

Besides the substances above mentioned, there is a fine red clay, of a compact, massive, or columnar structure, which is found in subordinate masses in the amygdaloids, sometimes pure, at others containing zeolites.

In this hasty outline of the minerals contained in the amygdaloid rocks, I am of course only describing the general characters of the amygdaloids themselves, and, therefore, must leave the reader to search for further details respecting these minerals in works especially devoted to the purpose; at the same time observing, that a separate description of them and their pseudomorphs, which have not yet been mentioned,

would form a most interesting and valuable contribution to the mineralogy and geology of India.

Of these pseudomorphs I need only notice here the passage of the radiated forms of zeolites into steatitic clay or steatite, and of glassy felspar by transition, into the latter; also the replacement of calcspar by crystalline quartz.

### Basaltic Dykes.

These are of course numerous in the trappean tracts, as well as elsewhere, and their structure prismatic and compact where they are not decomposed, the columns being perpendicular to the surface planes. Colonel Sykes mentions one which cuts through the basalt and amygdaloid in the top of a mountain within the hill-fort of Hurrichunderghur, which, as before stated, is 4,000 feet above the level of the sea. He also mentions dykes in the hills about Poona and the Bhore Ghaut. All these must of course have existed before the trappean plains were broken up. Mention is frequently made of basaltic mountains, which are completely isolated from the main tract by a vertical fissure or ravine with perpendicular sides, of only a few feet in breadth, and of a great depth. These may have been formed by dykes of more perishable matter, which have become decomposed, and carried away by the rains.

### *Laterite.*

This rock *par excellence*, that is where it caps the trappean mountains, is essentially composed of red iron clay, the iron of which, by means of segregation, has formed itself into cells and irregular tubes, chiefly at the expense of the clay which is contained in their interior; hence the lightness in the colour, diminished quantity, and soft and greasy nature of the latter, whilst that on the exterior of the tubes remains red, and retains its original harshness to the touch. This causes the white and red colour in the rock, and is a process which appears to be continually in operation. The inner surface of the tubes is smooth, and frequently mammilated, and the exterior, of course, rough; while their walls are composed of brown hematite, presenting more or less of a metallic lustre. A steel-grey oxide of manganese (Pyrolusite) not unfrequently takes the place of the oxide of iron, or, mixing with it, forms the greater part of the mass, and the purple violet tint which this rock sometimes assumes, Newbold thought might be owing to the presence of the former. The contorted, irregular tubes, which are frequently so numerous and near together as to give the mass a cancellated structure throughout, are generally about half an inch in diameter, but

vary every moment, in contracting and expanding to much beyond or within this size. They also frequently inosculate with each other, but seem, on the whole, to have a vertical direction, if we may take our type from the laterite at Beedur (Voysey). At this place, also, Newbold traced one downwards for 30 feet, which, after all, opened on the side of the rock. Sometimes the whole mass passes into pisiform iron ore without the tubes (Mm. Bradley). When exposed to the air, its surface becomes black, and presents the black or irridescent metallic lustre common to some forms of brown hematite.

Laterite of this composition and structure caps the highest trappean mountains, which terminate in level summits. At Mahableshwur it appears to be at least 100 feet thick, and at Beedur, on the opposite or eastern confines of the great trappean district, is in one part 200 feet deep (Newbold), where it rests on wacken passing downwards into basalt (Voysey). Wherever it appears on the trappean rock, whether in Malwa, at Ammerkuntak, on the Rajmahal hills, or in the Southern Mahratta Country, it presents the characters above given, and always rests on what has been termed "overlying trap." It by no means, however, exists continuously throughout the great trappean district, but chiefly on the summits of the highest mountains, where its scarped sides (like those of the overlying basalt beneath it) and horizontal summits characterize its presence from a long distance.

Various opinions have existed respecting the origin and geological age of the "laterite," but I shall only mention here those which appear to me most rational, and most in accordance with my own observations. Voysey and Christie classed it with the overlying trap, and Voysey made the following note upon it, dated 26th September 1819, viz. :—"I commenced on the hill of Beedur, and this morning rode to the north-westward. I everywhere saw basalt at the foot of the hill, passing into wacke and iron clay; in one place the transition did not occupy more than 3 feet, and was distinct."

Few who know the penetrating sagacity, ability, and truthfulness which characterize this author's observations, would be inclined to doubt the fact which this note reveals, viz. that the *basalt* passes into the laterite, whether by transition through the wacke is not clearly stated; but as the hill of Beedur is capped with laterite, the wacke to which he alludes must be between it and the basalt. "Iron clay" was Voysey's name for laterite; and when we reflect on the intense blackness of the overlying basalt, especially that of Bombay, compared with that of any of the other trappean effusions, and remember that in its course to the surface it must have passed through

or between the great beds of siderocriste (specular iron ore), of the gneiss, and other metamorphic strata abounding in oxidulated iron ore and manganese; and that circumstances which were not present when the former trappean effusions were passing through them might have caused the overlying basalt to have brought away a much larger portion of these minerals than any other effusion which preceded it, we shall not be altogether at a loss to account for the quantity of iron ore and manganese in the overlying basalt, and its tendency in particular to pass into laterite, where these minerals have become aggregated and exposed.

As it is the overlying basalt which passes into the laterite, the latter must be of the same geological age as the former; and as we have come to the conclusion that the great trappean mountains of the Western Ghauts were not elevated until this was ejected, the laterite must belong to some of the latest of the trappean effusions.

From what has been stated of this formation, it must also follow, that it may rest on other rocks which are older than itself, besides those of the trappean system, which is the case. Again, the percolation of water through a rock so highly impregnated with iron as the laterite, might induce a similar change in the one immediately below it, which also appears to be the case, while the *debris* of the former, descending to the valleys, or accumulating on the sea coast, may form secondary laterites. Hence it becomes necessary to find out some specific character for the laterite overlying the trappean effusions; and this seems to be the absence of all grit, gravel, and the fragments of foreign rocks. This, however, will not be sufficient when the basalt giving rise to the laterite may have formed a breccia with the rock through which it has passed, as in the granite hills of Ganjam in Cuttack (Sterling); but its local connections will then serve to explain the anomaly.

There are yet other instances in which laterite may be found, to which I will now briefly allude.

On the plateau of the Neilgherries, which is not without its dykes of trappean rock, viz. basalt, Benza states that there is 40 feet of lithomargic clay of a yellow-red colour, streaked with red and yellow beneath, formed from the decomposing surface of the syenitic and hornblendic rocks on which it rests; the felspar and hornblende going first, and then the quartz, in a friable condition; while lateritic conglomerates, too, of *rounded* pebbles, exist on each side of the Moyar river.

Again, in sinking a shaft in the vicinity of Bangalore, which is 3,000 feet above the level of the sea, Lieutenant Baird Smith, at 2 feet below the surface, came to variegated lithomargic earth, which at 15 feet

began to get slightly more tenaceous, and present felspar in the form of a white earth. This lasted till the shaft reached 20 feet, when the decomposed rock began to assume its real form, and at 22 feet proved to be a pegmatite.

On the opposite side of the raised land of the south of the peninsula, at the Bisley pass, it is stated by Newbold that sectile laterite overlies gneiss, which is veined with granite; and the Rev. Mr. Everest has stated that at Bancureh, on the road from Calcutta to Benares, granite is seen to be decomposing "into sand and grit, in which are imbedded masses of a quartzose reddish-brown slaggy-looking ironstone," the hollows of which are numerous, irregular, and mammillated inside, and which he considers to have arisen from the decomposition of the granitic rocks, which in two or three places present veins of it cutting through them.

So that there are various kinds of lateritic rocks and beds, but they must not be confounded with the laterite which caps the trappean mountains, or forms the upper part of the overlying basalt in other places.

## IX.

### Intertrappean Lacustrine Formation. (H. J. C.)

This name is derived from its position in the trappean effusions, where it has been chiefly noticed. No doubt it exists or has existed on other rocks, but it is only in one instance that this has been satisfactorily demonstrated.

It has now been found almost throughout India in connection with the trappean rocks, that is, a lacustrine formation exists under the columnar basalt of Cutch, of Malwa, on the Rajmahal hills, remnants on the isolated hills of Medcondah in the Hydrabad country, in the neighbourhood of Nagpore, in the Gwailghur hills, the Sichel hills, and in the island of Bombay.

Its position appears to be under the overlying basalt, and resting on amygdaloid, which, being a subsequent effusion, has separated it from the rock on which it was originally deposited.

It consists of argillaceous and argillo-calcareous shale, more or less indurated, chertified, or rendered jaspideous by heat, and from an inch to 40 feet in thickness; and in some places of limestone. Vegetable and animal remains abound in it, as will be described hereafter.

Voysey appears to have been the first who noticed this formation. He found, in 1819, fossil shells belonging to it 2,000 feet above the level of the sea, on the summit of the hills of Medcondah mentioned, which consists of trappean rocks resting on granite, about 150 miles due east

of Beedur, and therefore the same distance from the eastern border of the great trappean district. He afterwards saw it in the Gwailghur hills, *in situ*, and gave a descriptive section of it, from which the following from above downwards has been compiled:—

| | |
|---|---|
| Nodular basalt, or wacken | 10 feet. |
| Earthy clay, stratified, of different degrees of induration, containing flattened shells of the genus conus or voluta | 2 ,, |
| Wacken, or indurated clay (almost always amygdaloidal) | 15 ,, |

Coulthard and Dr. Spry afterwards gave the following sections, respectively, of the trappean effusions at Saugor in Central India, which also appear to include this formation. The former of a "swell of trap," the latter of a "well":—

*Section of the "Swell of Trap."* (Coulthard.)

| | | |
|---|---|---|
| "Rubbish and soil | 1 6 | feet. |
| "Indurated wacken, in angular pieces of uniform arrangement. | 10 6 | ,, |
| "Wacken changed into a species of puzzalama | 1 0 | ,, |
| "A thin black streak, (rather remarkable,) a vegetable deposit | 0 3½ | ,, |
| "A white hard earthy limestone, sometimes effervescing weakly with acid, sometimes not at all, with small yellow specks of calcareous spar. | 23 0 | ,, |
| "Wacken, with fibrous carbonate of lime, and ditto in veins with calcedony | 7 0 | ,, |
| "An amygdaloid wacken, similar to the toadstone of England. | 6 0 | ,, |
| | 49 3½ | feet." |

In allusion to the "Travertin" mentioned in this section, Coulthard states:—"but to the trap, not to the sandstone, belongs a hard, white, earthy limestone, harsh and gritty to the feel on the fracture, and in which, rather sparingly, are imbedded small round particles of calcareous spar, of a yellow colour. It belongs to the trap, and is, moreover, ever attendant upon it, throughout the range."

*Section of the "Well."* (Spry.)

| | | |
|---|---|---|
| "Surface soil | 3 | feet. |
| "Soft basalt | 2½ | ,, |
| "Hard basalt | 7 | ,, |
| "Soft basalt | 1½ | ,, |
| "Wacken, with nodules of limestone | 3 | ,, |
| "Travertin, with imbedded shells | 1½ | ,, |
| "Coarse siliceous grit | 2 | ,, |
| "Hard basalt | | |

The Society's museum now abounds in beautiful specimens of shells and other organic remains from this formation at Saugor, which have

been presented by Dr. Spilsbury and Captain W. T. Nicolls. The latter (P. MS.) confirms Dr. Spry's observations, with a little difference, and gives as a section 20 feet from the "well" :—regur; columnar basalt; brown or chocolate fine clay, breaking with a conchoidal fracture, and imbedding shells *(Physa)*, separate and in blocks of nodular limestone; tuffaceous nodular limestone, mottled red; and fine red clay again, resting on "volcanic indurated clay?" ;—while about 150 yards from this, the regur rests on chalky limestone which contains "*Physa Prinsepii*," and overlies blue or red clay, containing small quartziferous cavities.

The next notice we have of this formation is that by Malcolmson, who saw it and its fragments in several places, but particularly in a "narrow band" at the pass of the Sichel hills, near Nirmul, projecting from the escarpment of a steep mountain composed of "nodular basalt, and capped by a stratified rock, which also appeared to be basalt. And at Hutnoor, a little further north, he observed a bed of it 12 feet thick, resting on reddish granite, also capped by basalt. Here it chiefly consisted of stratified limestone, richly charged with bivalve shells (*Unio Deccanensis*).

From the shells and other organic remains which Malcolmson collected from this formation, the following descriptions have been given by Mr. J. de C. Sowerby :—

"*Chara Malcolmsonii.*—Oblong, spheroidal, with 10 ribs; three of the ribs are produced at the apex.

"This capsule is composed of 5 tubes, each of which is curled twice round. The figures represent a cast of the interior, the tubes being split down, and the outer halves broken away, and left in the chert. The specimens are silicified, and constitute almost the entire mass of the rock, in which they occur associated with *Physæ* and *Paludinæ*.

"*Cypris cylindrica.*—Twice as wide as long, almost cylindrical; front very slightly concave; the outer surface, which is very rarely obtained, is punctured.

"*Cypris subglobosa.*—Sub-globose, triangular, inflated; front concave.

"The outer surface of this crustacean is punctured, as in *C. cylindrica*.

"Both species occur abundantly in grey chert, with the *Unio Deccanensis* and other shells, and in various specimens of chert and indurated clay, containing *Gyrogonites*, *Paludinæ*, *Physæ*, and *Limneæ*, from the Sichel hills. The fossils are converted into calcadony.

"*Unio Deccanensis.*—Transversely oblong, rather compressed; margin internally waved; shell very thick; surface finely striated. Fig. 6 is in limestone from the northern descent of the Sichel hills; the others are in chert from Munnoor.

"This species has often a ridge, which bounds the posterior portion, and is variable in size and elevation. Fig. 9 is from a part of a group of many individuals of nearly one size, badly preserved in the same limestone as fig. 6; but as they are regularly oval, and do not show a waved margin, they may belong, as

well as fig. 10; which is in grey chert from Munnoor, to a species distinct from *U. Deccanensis*. Some flattened specimens from this limstone are 2¼ inches broad.

"*Unio tumida*.—Transversely obovate, smooth, gibbose; posterior extremity rather pointed; beaks near the anterior rounded extremity.

"The section of the two valves united is regularly heart-shaped. The shell is rather thin, and it has something of the contour of *Cyrèna*. It occurs in the same limestone with fig. 6, and the substance of the shell is replaced by calcareous spar, which cannot be broken so as to show the hinge.

"*Limnea subulata*.—Subulate, elongated, smooth; spine equal in length to the body; whorls five. In a nearly white, soft, siliceous stone, from Munnoor and Chicknee.

"*Physa Prinsepii*.—Ovate, rather elongated; smooth; spire short, body-whorl largest upwards. The largest are 2½ inches long, and upwards of an inch broad.

"*Melania quadrilineata*.—Subulate; whorls about eight, with four striæ upon each; aperture nearly round. Fig. 17, in grey limestone from the same locality as figs. 6 and 11.

"*Paludina Deccanensis*.—Short, conical, pointed, rounded at the base; whorls 5 or 6, slightly convex; aperture round."

Malcolmson also recognized shells of this formation in specimens of chert from the hills about the ruined city of Mandoo, in Malwa, already mentioned, which were presented to the Society by the late Lieutenant Blake.

Next in order of occurrence, but by far the most ample and satisfactory description that has yet been given of this formation, is the following by the Rev. W. Hislop, which is extracted from his "Geology of the Nagpur State," to which I have before alluded.

"The *Freshwater Formation*, which really does yield fossil fruits and other organisms, is nearly co-extensive with the great outpouring of basalt on the west of Nagpur. Whether it ever existed where there is now no trap to be seen is a question which I shall not stop to discuss. But it is a remarkable fact, that wherever there is overlying diorite to preserve it, there the freshwater deposit is almost sure to be found, unless it has been burnt up by the intrusion of amygdaloid. We have traced it well nigh without interruption for 100 miles towards Elichpur, and throughout the whole distance differing often in colour and composition, in outward appearance and inward structure, but still maintaining the same general relation to the enclosing rocks. It is to be met with of all hues, and of all mixtures of tints: at one place it is calcareous, at another siliceous, and at a third clayey. Here it is crystalline, there cherty, and again scoriaceous. In one spot it is full of fossils, in another and neighbouring locality it is utterly devoid of all traces of ancient life. I know not one intrinsic feature that is character-

istic of it. In judging of its identity, the only sure guide to go by is its position between the nodular trap above and the vesicular trap below. Though it must be spread over vast table-lands of different elevations, yet it is almost exclusively on the escarpments of these that we can acquire any knowledge of it. Generally the imbedded stratum occurs at a distance of 15 to 20 feet from the flat top of the eminence, just at the place where the water in the monsoon, running down the slope, has gathered strength sufficient to make an impression on intervening barriers, and whence it proceeds to plough up the soft subjacent amygdaloid, till it reaches the bottom, leaving an interval between each runnel like a rounded talus. In making your way up the ascent, your attention may be attracted by a number of blocks at the foot, which have fallen, or been washed down, from the site of the deposit. These increase the nearer you approach the exact spot; and if they suddenly cease, you may be sure, whether you have observed it or not, that you have just passed by the stratified rock, and come upon the nodular basalt. The thickness of the deposit is very various. It ranges from 6 or 7 feet to an inch. The former must have been its original development in this part of India; and where it has been reduced, the change must be attributed to the amygdaloidal intrusion from beneath. In the neighbourhood of Nagpur it does not average a thickness of more than one foot; where it is greater, the upper portion is generally indurated, and the lower remains soft. It is in the former that most of the fossils are found, though where the latter consists of a green and purple clay, the calcareous nodules, which have been aggregated in it, for the most part enclose organic remains. Among the fossils which this formation yields are the following:—

"*Mammalia or Reptilia* (?)—In addition to the part of a femur and the phalanx, before alluded to, as having been found at Junyápáni Chouki, which I am inclined to refer to this deposit, there have been discovered in it, about two miles west of Nagpur, a portion of a vertebral column, consisting, apparently, of eight vertebræ, and, not far from the same spot, a number of minute bones, in a detached and very fragmentary state, belonging to all parts of the animal structure. Whether these remains of quadrupeds are exclusively of reptiles, or whether some of them may not also be mammalian, I do not possess knowledge enough to warrant my expressing an opinion; nor is it necessary that I should, seeing they are to be transmitted to London, and will soon be examined by those who are competent to the task. But I may mention, that the teeth discovered among them indicate the former existence of saurians at the locality, one tooth being small and

obtusely conical, with a barbed point, and another species, which is very abundant, being comparatively flat and lancet-shaped, with the enamelled side of a darkish slate colour. To this class also may, perhaps, be referred a claw, half an inch long, brought to light at Telankhedi, three miles west of Nagpur; while the stratum at Machhaghodá has furnished the impression, apparently, of a freshwater tortoise.

"*Fishes.*—Remains of this class are found at Tákli and Machhaghodá, but chiefly at Páhádsingha. They consist for the most part of scales, some of the Ganoid and others of the Cycloid orders. The Ganoidians are probably to be referred to the Lepidotoids, to which the spinous rays collected with the scales may have belonged. The alternate depressions and elevations, which radiate from the centre of the Cycloidian scales, are beautifully preserved; some have 12 of each, and others a smaller number. One specimen, as was pointed out to me by that well-known naturalist Dr. Jerdon, has constituted part of the lateral line, and still bears the tube through which the mucus flowed that anointed the surface of the body. But the most curious object that has been met with in this department is a piece of a roe found at Tákli, in the two lobes of which the ova that had been matured are calcedonised, while countless minute granules are seen lining the ovarian membrane.

"*Insects.*—The exuviæ of this class are more numerous than might have been anticipated. They are found only at Tákli, and are chiefly elytra of beetles, of which 9 species have been discovered, 7 having rewarded the investigations of Mr. Hunter. Some are allied to the Buprestidæ, another, in the opinion of its accomplished discoverer, is connected with the (soft-bodied) Heteromera, while two tuberculated elytra may possibly have belonged to some other family of the same tribe. In one of the fruits, to be mentioned below, there was found a hollow tube, binding together several of the surrounding seeds, and absorbing the juice of their enveloping pulp: this was, perhaps, the work of some one of the Dipterous order; and on a piece of silicified wood, which at the period of its deposition must have been considerably decayed, there was discovered a large number of little round opaque bodies, regularly arranged in a hollow. Can these have been the eggs of one of the Lepidoptera?

"*Crustacea.*—Of this class no order occurs except the Entomostraca, comprising the genus Cypris, with 6 species, all new, so far as I am aware; and a very interesting genus, which I am disposed to consider allied to *Lynceus* or *Daphnia*.

"*Mollusca*.—These are very numerous, consisting of *Melania quadrilineata* (Sowerby), and perhaps another species of the same genus not described; *Paludina Deccanensis* (Sow.), and 8 species not named; 4 species of *Valvata*, new; of *Limnæa* besides the *subulata* (Sow.) 5 new species; of *Physa* in addition to the *Prinsepii* (Sow.) 4 or 5 new forms, that may constitute as many species; of *Bulimus* 2 new species, with 12 other species that may be referable to the same genus; *Succinea* 1 species, and *Unio Deccanensis*. Most of the Paludinæ have been found at Tákli, along with the two well-marked species of Bulimus. Telankhedi has supplied all the Limnææ, the doubtful Bulimi, which in many cases retain a stripe of colour on the shell, and the single species of *Succinea*, of which only one specimen has been met with. One species of *Valvata*, with a pretty striated spire, most frequently truncated, is found exclusively at Tákli. Another, also striated and conoid, leaves its impressions abundantly on the rock around Nagpur. Two without striæ occur at Machhaghodá, one carinated above, and sometimes conical, and at other times oblong-conical, and the other discoidal, and so minute as scarcely to be visible by the naked eye. *Physa* is the genus most extensively diffused, having been collected in all places where the deposit is fossiliferous. Besides the *P. Prinsepii* (Sow.) there is one new form found at Telankhedi, which presents obvious specific differences; and there are several others varying from both of these, but by such gradual changes, that under a sense of incompetency, I have sent them all to London for determination. The only remaining shell that has fallen in our way is *Unio Deccanensis* (Sow.), which was obtained by Mr. Hunter at Chikni, the locality pointed out by Malcolmson, which is the only locality for it that I as yet know of within the territory of Nagpur. The specimens of it that occur there are far from good, when compared with those kindly sent me from the neighbourhood of Elichpur by Dr. Bradley. That able and zealous geologist has also furnished me with excellent specimens of *Physa*, the forms of which agree with those common in the vicinity of Nagpur.

"We pass now to the vegetable kingdom, the specimens of which from the freshwater formation are both rare and varied. They may be classed under the heads of fruits and seeds, leaves, roots and wood.

"*Fruits and Seeds*.—Of these there are about 50 species. The order of the Exogenous sub-kingdom, that has most representatives, is the *Leguminosæ*, there being 4 species very obvious, viz. two *Hedysareæ*, and other two, including a *Cassia* of the more regular flowered division of the order. Under the same head may be arranged what appears to

be a *Faboidea* of Bowerbank, a double-seeded fruit resembling the *Xylinoprionites* of the same author, and a three-seeded one, occurring sometimes with two seed-vessels, and at other times with three, which may have been a *Hedysarea*. The most abundant order of Endogens is *Aroideæ*, of which there are two genera, with compound fruits, one with three-seeded ovaries, in size and outward appearance being exceedingly like a small pine-apple, and the other genus bearing a distant resemblance to a mulberry, having, however, the seeds in each vessel symmetrically disposed in sixes. This latter genus contains two species: one, that must have had a rich purple pulp, was upwards of an inch in length, and half an inch in breadth; and the other extended to 2 inches long, with a breadth not exceeding $\frac{1}{8}$ of an inch. Next to the *Aroideæ* the most interesting Endogens are *Palms*, of which there seem to be two genera, one a *Nipadites*, (Bow.) and the other one a transparent piece of calcedony, whose place in the order cannot exactly be assigned. For the latter rare specimen, as well as for the larger mulberry-like aroid fruit, and many other fruits and seeds, we are indebted to Captain Wapshare, whose co-operation in this field has proved of the highest value to Indian palæontology. The fruits above specified, in common with those not mentioned, are almost all found at Tákli. The only exceptions worthy of notice are one of the *Hedysareæ*, which was laid open in a stone from Machhaghodá; separate ovaries of the larger six-seeded aroid, which are found along with fish-scales at Pahadsingha, and the *Chara Malcolmsonii*, which is met with, though not abundantly, wherever the deposit contains organic remains.

"*Leaves*.—Of these there are 12 kinds, seven of which are Exogenous. In some of these the secondary veins strike off from the primary at a very acute angle, and in others not so acute, while in one of orbicular shape they radiate from a central point like the leaf of *Hydrocotyle*. The Endogenous leaves are five in number, some of which possess a considerable similarity to those found in the Bombay strata, and figured in Plate viii. of this Journal for July 1852. All these have been obtained at Tákli, as also the roots.

"*Roots*.—These amount to five in all, none of which are much above an inch in length. The most conspicuous forms among them are those that are somewhat like a cocoon, marked by the scars of sheathing bracts. Of such tubers there seem to be three, differing in certain respects from each other, and agreeing in number with the three aroid plants, with which they are found invariably in juxtaposition. The similarity of one root in all but the size to that given in Plate vii. fig. 1 of the able paper just referred to, cannot fail to appear on the most

cursory examination, and may serve to fix the place of the latter in the vegetable kingdom, as well as create the hope of finding near Bombay some aroid fruit which it has produced.

"*Wood.*—There seem to be three kinds of Exogens and two of Endogens. In some cases the former retain their bark, while the latter, as has been observed in other Indian localities, occasionally display their aerial roots. Specimens of wood are common in almost all fossiliferous parts of the territory.

"From a review of the whole fossil contents of this formation, the inference to be derived appears to be, that it cannot be more recent than the Eocene era. Bronn, in his Index, has set it down as of the same age with the Continental *Molasse;* but the facts, that out of the many shells it has embedded not one within my knowledge is specifically the same as any now existing, that there is almost an equal number of Ganoidian with Cycloidian scales, and that the fruits bear a remarkable resemblance to these found in the London clay of the Isle of Sheppey, in my humble opinion fully warrant the belief that it is one of the oldest of tertiaries. On the tempting theme of its extent throughout India I forbear to enter."

Lastly, we come to the lacustrine strata in the island of Bombay, which I examined in 1851, and have described in No. XVI. of this Journal.

These, which lie under 50 feet of black, stratified basalt, and rest on intruded amygdaloid, like the foregoing, consist entirely of argillaceous shales, which superiorly, where they approach the basalt, are of a light brown colour, and inferiorly, where they are intruded by amygdaloid, of a dirty green or blackish colour. They are laminate in structure, and homogeneous in composition, where they have not been altered by heat; the fossils, even, have all become argillaceous; and although here and there, may be seen a coarse, granular, and apparently heterogeneous stratum, lying between others of extremely fine texture, still the material of which that also is composed is soft, sectile, and argillaceous. It is only where these strata have been exposed to heat that they become altered, and their fossils, and every other part of them have passed from an argillaceous into a cherty or jaspideous state.

There is one exception, however, which is of much importance, viz. that here and there also imbedded in these strata are found fragments of unmistakeable *vesicular scoriæ.*

The deposit abounds in organic remains throughout, but they are much better preserved in the lower than in the upper part. Above, the vegetable remains have been entirely decarbonized, while below,

they are still carboniferous, and in many instances present thin laminæ of sparkling grains of coal.

The superficial stratum, or last deposit, which is about three inches in thickness, is characterized by its siliceous composition and oolitic structure, being almost entirely composed of the casts of *Cyprides*, with a few small fragments of stems of plants. Above this comes only two or three inches of argillaceous transitionary matter, which passes into the wacken of the overlying decomposed basalt, and the wacken again, into the compact basalt above all, through the nodular disintegration of the latter.

Fragments of reeds or stems of plants and their leaves, seeds, and numberless other fossils, apparently from the vegetable kingdom, the forms of which have become obliterated, abound in the light-coloured strata, the fragments particularly in layers, as if they had been deposited more at one time than another, perhaps by floods after heavy rain. About the middle, where the strata have not been wholly decarbonized, and the colour changes to dark green, cormiform roots abound, the remains of small frogs (*Rana pusilla*) in great numbers on black carboniferous laminæ of shale, and of a fresh-water tortoise (*Testudo Leithii*). Dr. Leith, who found several specimens of the latter, also subsequently presented to the Society part of the lower extremities (the *tibiæ*) of a frog, which he computes to have been about three inches long, from the same formation. Below this comes the most carboniferous part of the series, which abounds in large pieces of dycotyledonous woods, flat long ensiform leaves, and a number of seeds, seed-pods, and other remains belonging to the vegetable kingdom. This part is impregnated with a napthous odour, and presents small deposits of sparkling coal throughout, in connection with the vegetable remains.

Besides the fossils mentioned, *Cyprides* abound in every part; a long species, *Cypris cylindrica*, perhaps, of the deposits on the eastern margin of the trappean district; another species not well characterized, and *C. semi-marginata*, which appears to be a new species. The elytra of insects, and impressions of shells like *Melania*, are also present, but the latter are too indistinct for description.

Calcareous spar abounds in the lower strata, where much of the shale effervesces when acid is applied to it; and in one part I found the portions of vesicular scoriæ to which I have alluded, the presence of which is important, because it seems to indicate that the trappean effusions had commenced before this lacustrine deposit had begun to be deposited.

As I have before stated, the lower part of this series has been found

intruded by amygdaloid wherever it has yet been noticed, and therefore neither its whole extent, nor the rocks on which it was originally deposited, are yet known. Its strata in a chertified and jaspideous condition appear, here and there, in all the trappean effusions of the island, except in the basalt, which overlies it; and the plains are strewed with their fragments, contorted and twisted into various shapes, from the almost melting heat to which they have been exposed.

For a more elaborate account of this formation in the Island of Bombay, I must refer the reader to my paper on the geology of this island, published in the No. of this Journal mentioned.

There is yet another instance to which we should direct our attention before we leave this part of the subject, where a similar deposit exists under basalt, in an insulated hill 250 miles to the eastward of the great trappean district. I allude to that pointed out by General Cullen to Dr. Benza, in the Northern Circars. It is situated about 5 miles to the west of Puddapungulla, a village near Rajamundry, just above the delta of the Godavery, and consists of a bed of limestone, lying apparently in "wacke." Benza has stated that the limestone is white, and glimmering, from the sparry nature of the fossil shells which are in it, and that it breaks with a semi-conchoidal fracture. The shells consist of "oysters, unios, small melaniæ, &c." The hill is capped with basalt, decomposing in spheroids and concentric layers, and the "wacke" below the limestone is traversed by thick veins, and small ramifications of jasper, the whole apparently resting on sandstone conglomerate.

It is just possible that this may be a marine tertiary formation, as we shall see hereafter; but its position in the "wacke" or decomposed basalt, and the resemblance at first sight of large unios to oysters, which led Malcolmson and Voysey to mistake the former for the latter, and may also have misled Benza, makes it very like a deposit of the intertrappean lacustrine formation.* The presence of sandstone conglomerate below all may also be useful to remember, as this may be the diamond conglomerate.

* As further instances of the mistakes which have been made in the nomenclature of these freshwater shells, the following may be cited:—Thus, Voysey considered those of the Gwailghur hills to belong to "conus and voluta"; those which he found in calcedonies among the *debris* of trappean rocks in the bed of a river at Daigloor, near Bhuktapore, "buccinum, helix, and turritella"; while Dangerfield considered those which he saw in Malwa to belong to "buccinum," and a "species of muscle." There can be very little doubt now, but that all these were either *Physa Prinsepii* or *Unio*, or other shells of the intertrappean lacustrine formation.

We now come to the evidence that has been communicated of the existence of this formation on other rocks besides the trappean effusions, and this is very scanty indeed. No one can doubt but that further exploration alone is required to prove its presence in many places; but as yet there is but a solitary instance on record to substantiate the fact, and this I have already mentioned, viz. the existence of a series of limestone strata, 12 feet in thickness, and richly charged with unios, which Malcolmson saw resting on "reddish granite" capped by basalt, at Hutnoor, in the Muklegandy pass, a little north of Nirmul.

Voysey, however, in his last journey, viz. that from Nagpore to Calcutta, came upon a bed of "oyster shells," which I think must have been unios, in limestone, at Dooroog, about 120 miles east of Nagpore; and of this he states:—"In my vicinity are numerous excavations of considerable dimensions, for the purpose of making tanks—the bottoms about 50 or 60 feet below the surface. In one, SE. of the town, there is a thick layer of limestone, of a reddish colour, which at first appears to be a kind of breccia, or pudding-stone, but on narrow inspection, it is evident that the whole consists of a thick bed of oyster shells, which have been in some cases completely petrified, and changed into a compact limestone; and in others, on fracture, conchoidal laminæ are very distinct. Perhaps it will be difficult to convince some persons that these are really petrified oyster shells, but I have not the slightest doubt that an experienced geologist will at once admit the fact. It remains to be ascertained whether the rock has a bituminous or ammoniacal smell before the blow-pipe. They appear to differ very little from the shells at Miaglah Condee, except that in this instance they are entire, whereas in the former place they are broken; here, also, they appear to have been compressed. The bed extends beneath the diluvial soil as far as the bed of the river, where there are a few scattered blocks." He found it again at Ryepore, some miles beyond Dooroog, in the bed of the Karoonuddi, and in the wells dug by Colonel Agnew and Captain Hunter, which are 50 feet deep, resting therein on clay slate; and in a quarry at the same place where the latter passed into sandstone; also some pieces of the same shelly limestone on his way to Chandcoory, and on to Bhainsa. At Lowun he mentions "black slaty limestone" underlying the diluvial soil, and that it is to be found on the river Mahanuddi; and at Beliaghur clay slate succeeded by reddish sandstone, where he makes the remark on the geological antiquity of these rocks already quoted. This sandstone extended on to Jora Devi; and in the Silman pass a little beyond, he saw "sandstone conglomerate immediately followed by the clay slate and shelly

limestone." At Bilaipore a breccia of the clay slate in a paste of quartz, "very few of the masses of which seemed much rounded by attrition." Then the usual sandstone, followed by the calcareous clay slate. "At Laindurrah sandstone appeared to be the prevailing rock, and at the top of the pass the calcareous clay slate." In the beds of the nullahs, clay slate "under the sandstone, which is, generally speaking, the lowermost rock." At Cordeonah, sandstone, beneath which is clay slate. Then, after passing over sandstone conglomerate, he states:—"I came on large bedded masses of granite, but did not see their junction with the conglomerate, on account of the diluvial soil; Granite continued on to Sumbulpore, then gneiss, and a little argillaceous limestone, after which metamorphic rocks and granite all the way to the Subunreeka." While at Sumbulpore, he visited the diamond washings in the Mahanuddi. The diamonds were sought for in the sand and gravel of the river, the latter consisting of pebbles of clay slate, flinty slate, jasper, and jaspery ironstone of all sizes, from an inch to a foot in diameter.

At first it would appear useless to follow Voysey through this journey in the hope of identifying his bed of "oyster shells" in limestone with the intertrappean lacustrine formation, on account of no allusion having been made to the "shells at Miaglah Condee," from which he states "they appear to differ very little,"—in any other part of his journals. But when we observe the close resemblance, both in name and permutability of spelling that exists between "Miaglah Condee" and "Muklegandy," by which the pass leading into the valley of Berar from the Nizam's territories is called, and connect this with the fact that at Hutnoor, in this pass, Malcolmson saw the lacustrine limestone strata richly charged with what he then conceived to be shells of "*Ostrea* and *Cardia*," but which afterwards proved to be *Unio Deccanensis*, &c. resting on "reddish granite,"—that which seemed to be hopeless of explanation appears to be perfectly intelligible, and the identity in name and geological formation complete. When, also, we consider that Voysey did not recognize the lacustrine nature of these shells any better than Malcolmson; that the only bit wanting to complete his itineraries is that between Hyderabad and Nagpore; while Colonel Lambton's northernmost station in 1819 was Shivalingapah, near the south bank of the Godavery, not far from Nirmul, where the Muklegandy pass commences; and that in 1822 he had carried his triangulation across the valley of Berar to Ellichpore; there is every reason to believe, from the nature of the country, that he carried it through the Muklegandy pass, and that Voysey, who was attached to his survey, had then plenty of opportunities, which he never allowed to

escape him, of witnessing among the portions of the lacustrine formation which is here exposed in several places, the very limestone strata and its numerous *Unios* which Malcolmson himself saw in marching through this pass in 1835. But, as I have before stated, this part of Voysey's journal is unfortunately wanting, and the only place where he seems to allude to this locality, is in his last notes between Nagpore and Calcutta, where he mentions the place in question, "Miaglah Condee." Colonel Lambton died at Hingan Ghaut, on his way from Hyderabad to Nagpore in January 1823, and Voysey left the latter place or its vicinity for Calcutta in February 1824; but he states in his "Report of the Geology of Hyderabad," that he had seen shells in the trap of Medcondah, and in the wacken of Shivalingapah; and in his account of those which he saw in the Gwailghur hills, in April 1823, he mentions that he communicated in June 1819, as has before been stated, in a report to the Marquis of Hastings, the fact of their existence in Medcondah, though we cannot trace him in his journals to either Medcondah or Shivalingapah. Again, it is evident, from the concluding part of his paper on those of Gwailghur, that he had seen freshwater shells of the intertrappean lacustrine formation in more places than he has mentioned.

Besides, who has yet seen anything like "beds of oyster shells" in limestone or calcareous strata in the interior of India, and what indications are there of such a deposit existing there in the formations hitherto described; none that I can see. Thus everything tends to the conclusion that Voysey's limestone strata with oyster shells at Dooroog, and the other places mentioned on his way to Sumbulpore, were parts of the deposit under consideration.*

We shall have to recur to this subject again by-and-bye, but in the meanwhile let us direct our attention to the intertrappean deposits of

* *Miaglah Condee* and *Muhlegandy* are almost undoubtedly the adjectival forms of مغل *Mughul*, viz. مغلي *Mughuli* or مغلية *Mughuliya*; and *Condee* or *Gandy* that of *Condah*, a common Telingi terminal affix to places in this part of India; while the Hydrabad country is called by the Mussulmans *Mughlai*; and then *Miaglah Condee* and *Muhlegandy* pass would mean the *Mughli Condi* pass, (pronouncing the vowels as in Italian,) or the passage from the valley of Berar into the *Mughlai* country. At the same time, it is not improbable that the third stroke of the *m* in the MS. has been mistaken for an *i* by the compositor, and that this has led to the strange spelling, "*Miaglah*," which has such an uncommon orthography that it seems that it must be incorrect. I am not an advocate for this kind of reasoning in scientific inquiry, and therefore only add these observations for what the reader may think them worth, in connection with the facts above stated.

the lacustrine formation in Cutch, and to the coal formation resting on the trap of the Rajmahal hills in Bengal.

Of the former, Colonel Grant only describes one instance, viz. that at the village of Wurrowsow, on the SW. flank of the Charwar range, of which he gives the following section:—

| | | | |
|---|---|---|---|
| "Columnar basalt | 20 | 0 | feet. |
| "Rubbly basalt | 0 | 6 | „ |
| "Crystalline travertin | 1 | 6 | „ |
| "Friable calcareous stone | 0 | 3 | „ |
| "Travertin | 0 | 6 | „ |
| "Friable iron clay | 0 | 3 | „ |
| "Solid basalt | 1 | 6 | „ |
| "Friable basalt | | | |

In this section we have the superficial basalt becoming rubbly or nodular as it approaches the travertin, and that below, as is commonly the case, apparently passing into the latter through a transitionary ferruginous clay. No organic remains were seen in the travertin.

The following description of the coal strata in the Rajmahal hills, which has been given by Dr. M'Clelland, is provisionally placed here, because it rests on the trappean effusions:—

"Rajmahal Coal Formation."

"This consists of thin beds of coal, shale, clay-ironstone, and sandstone, forming the upper beds of coal formation, resting on enormous beds of secondary trap.

"These appearances were examined with great care at Mussinia, Dhomaripore, Taldee, Kottycoon, and Dubrajpore; and found to be everywhere so much alike, as to leave it in considerable doubt whether they do not all refer to one and the same set of strata, appearing at each of the various points alluded to.

"The district in which these appearances occur is mountainous, the levels varying from 50 to 1,500 feet above the sea. It is reasonable, therefore, to conclude, that if good workable beds of coal existed, they would be somewhere brought to view amidst so much local disturbance.

"The higher ridges of these mountains consist of scoriform masses of red earthy vesicular conglomerate (laterite), containing angular and other fragments of altered coal measure shales, ferruginous and micaceous sandstone, imbedded in a semi-vitrified and vesicular matrix. These ridges are without any signs of stratification, except where detached masses of altered coal formation occur; while the upper portion of their declivities, as well as all the lower and intermediate ridges, are composed either entirely of amygdaloid trap, containing

zeolites and calcedony, or altered coal measure sandstone and shale, the latter passing into the small isolated patches of coal measures which are found in some of the narrow valleys and ravines already mentioned.

"These coal measures would appear to have been the object of repeated and fruitless attempts on the part of coal finders, to discover workable seams.

"But such is the development of secondary trap throughout this district, that no hopes can be held out of any useful results from such trials.

"This remark is only intended to apply to that portion of the Rajmahal hills which has been examined by the survey, lying south of Pátchwary, or between that place and Bulleah Narainpoore. It applies, however, to all those localities in which coal has been stated to exist in the Rajmahal hills (vide Reports of the Coal Committee), except Hurra and Siclygully, which yet remain to be examined, together with that portion of the hills extending from Patchwary Pass northward to the Ganges."

The computed section of these coal strata gives about three times as much fine and coarse, more or less micaceous sandstone and conglomerates as bituminous shale;—carboniferous shale about one-fifth as much;—the coal strata very trifling, viz. 1 to 6 inches in thickness, and near the surface;—with altered sandstone and conglomerates at the bottom, followed by altered shale, each about 22 to 26 feet,—resting on amygdaloid.

One section, viz. that at Kottycoon, is of 100 feet, and the stratum of coal 2 inches; the other, viz. at Mussinia, 116 feet, and the stratum of coal 6 inches.

The coal lies between bituminous shales, about 16 feet from the surface.

Of the coal measures at Kottycoon, Dr. M'Clelland states:—

"These thin coal measures rest in horizontal strata, on beds of hornblende slate (Rûttunpore Ghat). They occupy a small space at the western foot of Dabrajpore or Umrah hill, the highest mountain in the district.

"The mountain consists of amygdaloidal trap, and semi-vitreous earthy scoriæ, having conglomerates and shale of the coal formation resting on its sides in broken masses and outlines, everywhere altered, and invaded by amygdaloidal trap."

In speaking of the amygdaloid and common trap of the Rajmahal hills, he states:—

"Common jasper of inferior quality also occurs, in beds connected with the clay ironstone of the altered coal measures, in the same locality."

Overlying the amygdaloid is his "common trap," which is avesicular, and of this he observes :—

"The higher ridges consist of scoriform unstratified masses of red earthy vesicular conglomerate, containing angular fragments of alternated coal measure shales, ferruginous and micaceous sandstones and conglomerates, imbedded in a semi-vitreous vesicular matrix."

Under the head of "Inferior Oolite" is then stated :—

"Resting on beds of overlying trap in the Rajmahal hills are certain greyish and bluish-white indurated clays, rendered slaty in places by the abundance of leaves of plants they contain. These clays have been altered by the contiguity of trap. They were originally stratified, but now exist in the form of hard, broken, and detached porcellanous masses."

The following vegetable impressions from this formation have been described by Dr. M'Clelland :—

"*Zamia Indica.*—Leaf long, and very slightly tapering ; leaflets short, rhomboidal, oblique at the base; seven nerved, nerves crowded, and alternately terminating before they reach the apex of the leaflet.

"*Zamia Theobaldii.*—Leaflets alternate, oblong, obliquely accuminate.

"*Tœniopteris spatulata.*—Frond linear, 2 to 3 inches long, narrow at the base, becoming broader towards the apex, or sub-spatulate.

"*Obs.*—This occurs very frequently.

"*Tœniopteris accuminata.*—Frond 2¼ inches long, linear-oblong, rounded at the base, accuminate towards the apex.

"*Obs.*—This is of more rare occurrence.

"*Tœniopteris crenata.*—Frond linear, 2 or 3 inches long, narrow at the base, and rounded at the apex ; margins laterally crenate.

"*Obs.*—These, together with *T. spatulata*, are so common, that it is chiefly to them the slaty structure of the bed in which they occur is owing.

"*Poacites minor.*—From beds of bituminous shale at Mussinia. It is the same as [*P. minor*, M'Clell.] of the Burdwan fossils."

In the Rajmahal hills, then, there is a formation, which, in the nature of its strata, its thinness (100 feet), and its connection with the trappean effusions there, closely resembles the intertrappean lacustrine formation of Central and Western India ; but more particularly, perhaps, that of the island of Bombay.

Yet its vegetable impressions, and the *Poacites* of the bituminous shale at Mussinia being the same as that of the Burdwan coal strata, would seem to point out that it belonged to the Oolitic Series, and hence

Dr. M'Clelland appears to have called it "Inferior Oolite," for I assume, that as the "Rajmahal Coal Formation" and "Inferior Oolite" of M'Clelland both rest on the "trap" of the Rajmahal hills, they are parts of the same system, if not the same deposits. One of three things, then, is evident here:—either the first trappean effusions took place during the Oolitic period; some of the species of plants of the Oolitic period continued to exist after its expiration; or (if by resting on the trap Dr. M'Clelland should mean adventitiously), these coal strata have been raised from the formation to which they belong, or from that on which they were originally deposited.

Pending the decision of these questions, I think the coal strata of the Rajmahal hills had better be provisionally classed with the intertrappean lacustrine formation.

In recapitulation of the facts given under this head which seem most deserving of our consideration, we find—

1*st*.—That in addition to resting on the trappean rocks, the intertrappean lacustrine deposit has been seen by Malcolmson to rest on granite in the Muklegandy pass, and that the limestone with oyster shells *(Unios?)* seen by Voysey on his way from Nagpore to Sumbulpore, would appear to belong to the same formation, reposing at one time on clay slate, and at another on sandstone.

2*nd*.—That the mention of the latter by Voysey, in connection with the existence of diamonds in the Mahanuddi which most probably came from the diamond conglomerate in the neighbourhood, has a resemblance to Franklin's description of the deposits accompanying the diamond in Bundelkhund; that this is increased by the fact that both in the neighbourhood of Saugor and Nagpore, where the trappean effusions become fringed out, the latter are attended by a distribution on the surface of fossils from the intertrappean lacustrine formation; and, that on the sandstone in Bundelkhund and the district of Saugor, a limestone exists which may hereafter prove to belong more to the intertrappean lacustrine formation than to the Oolitic Series.

3*rd*.—That there is a great similarity in position, and trappean disturbance and admixture, between the coal formation of the Rajmahal hills and the lacustrine formation in the island of Bombay; that the coal in the latter, too, which is described in vol. iv. of this Journal, p. 176, is not brown coal, such as we shall come to by-and-bye, in the deep blue clay deposits of the coast, which will also appear to come near its own age, nor lignite, such as we shall find in the more recent formations of the same locality, but a degree further advanced towards the old coal of the Carboniferous Series; also that we have,

in the island of Bombay, these strata subsequently intruded by trappean rocks in the form of conglomerates and amygdaloids, just as described by Dr. M'Clelland in connection with the coal formation of the Rajmahal hills. What influence the heat from the overlying basalt and subsequent trappean effusions may have had in approximating the carboniferous deposits in the lacustrine strata of Bombay to the state of old coal I am ignorant.

*4th.*—That the strata of the intertrappean lacustrine formation have, in many instances, been lifted out of their original position, and sometimes so divided, as to appear in thin strata, in differents parts of the trappean effusions which have invaded or enveloped them. This is very well seen in the island of Bombay, where in one place a stratum one foot thick lies under 90 feet of trappite, and then comes 20 feet more of the same rock below it, after which follows volcanic breccia, containing portions of the other parts of the lacustrine strata. In Malcolmson's description of the Muklegandy pass, he states that there are three terraces leading from the summit downwards into the valley of Berar. The summit of the pass is composed of basalt; and on descending to the first terrace, he found "fragments of a compact blue limestone, not to be distinguished from that of the diamond districts," the strata of which were much inclined and broken. Then, on descending to the second terrace, he found the white limestone strata charged with *Unio Deccanensis*, &c. already mentioned, lying on granite, and again overlaid by basalt. While we learn from Dr. M'Clelland's description of the coal formation on the Rajmahal hills, that this also rests on enormous masses of "secondary trap," and that it has been extensively broken up by subsequent effusions; also that there are porcellanous masses of indurated clays resting on the overlying trap of these hills, which contain fossils of the "Inferior Oolitic." He further mentions, that in one part, the coal strata rest "horizontally on beds of hornblende slate."

*5th.*—Lastly, that the intertrappean lacustrine strata in Bombay contain straggling pieces of hollow vesicular scoriæ.

From these facts, then, we may deduce the following conclusions, viz. that some of the lacustrine deposits might have taken place prior to the first trappean effusions; that in the island of Bombay the presence of scoriæ indicates that this deposit, at least, was going on during the trappean period; that generally, these lacustrine deposits in the Deccan, where they are connected with the trappean effusions, lie under a capping of basalt, and that they have all more or less been raised from their original position by the intercalation of amygdaloid.

## X.

### VOLCANIC ROCKS.

Trappean System, 2nd Series... { *Trappite.* *Amygdaloid.* *Volcanic Breccia.*

The second series of trappean effusions includes all those which have taken place in India since the elevation of the Ghauts.

Subsequent to the breaking up of the trappean plains, and the upheaval of the stupendous masses which form not only the Western Ghauts, but all the ranges of mountains upon the great trappean district, a series of effusions appears to have been ejected between the elevated ridges of the old trappean tract, as well as in other parts at a distance from it, all of which now assume the form of low hills or plains, occupying a variable extent of surface.

In the island of Bombay they consist of trappite, amygdaloid, and volcanic breccia; and they are all characterized by enveloping more or less of the intertrappean lacustrine strata, or of other rocks. The same is the case with similar effusions on the Rajmahal hills. Malcolmson also states, that on the banks of the Pennar he saw a breccia, formed of the "diamond sandstone" and a semi-vitrified rock, which he hesitated to refer to the trap family "until he had seen varieties of a red wacke," much resembling it, which constitutes part of the mountains in the island of Salsette; and Captain Meadows Taylor, in a private letter to me, accompanied by a sketch-map, points out the existence of large tracts of indurated trap-mud or clay, including blocks and nodules of basalt, which bounds the south-eastern border of the great trappean district between the Bhima and the Kistnah, and overlies in its outskirts the adjoining granitic rocks and limestone of the Oolitic Series. Many other instances of this effusion no doubt exist in other places, though they have not yet been mentioned.

*Trappite.**—The characters of this rock have already been given, and all that I have to add here is, that a bed of it exists in the island of Bombay, from 0 to 150 feet in thickness, the upper surface of which

* That which I have called "Diorite" in my "Geology of the Island of Bombay" should have been termed "Trappite," for it possesses throughout the character which we have assigned to the latter to distinguish it from diorite, viz. semi-crystallization and the presence of an amorphous earth. I would rather, too, not consider it a modified form of the overlying basalt, which led me to call the two in combination "the basalto-dioritic tract"; but as a separate effusion, until it may be more satisfactorily demonstrated that it is really a part of the overlying basalt.

is tesselated in the manner of other rocks that have from a semi-fluid state become consolidated in contact with the atmosphere; while it envelopes long tracts of strata, which have been thus isolated by it from the intertrappean lacustrine formation. In one instance there are 90 feet of trappite above, and about 40 feet below, a stratum of this formation, which is only from 1 to 2 feet in thickness. One ridge or dyke of this trappite presents the peculiarity of being mottled with darker coloured portions than the rest of the rock, and these remaining almost intact while the lighter coloured part weathers away, causes it to assume the form of a conglomerate of bullet-like masses, of different sizes, from which I have termed it "Orbicular Diorite"; it should be called "Orbicular Trappite."

*Amygdaloid.*—This, formed of a trappitic base more or less aphanitic or amorphous, is chiefly characterized in Bombay by the presence of laumonite, calcspar and quartz in its cavities. In some parts all three are present, in others they are alone, and are then most developed. It has invaded the lacustrine strata to a great extent, and broken them up into masses, which now lie imbedded in its structure, or in the form of chert and jasper, twisted and contorted in all directions and strewed about its decomposing surface. In colour it varies from blue to fawn or brown. In the latter state it has been called "White Trap," and in the quarries where it is least vesicular, presents a prismatic, columnar structure, like that of the black basalt. In many parts it is impregnated with calcspar, which only becomes visible when its planes of crystallization arrive at a position favourable for reflecting the rays of light towards the eye. In this state it appears to form spilite (Brongniart). The light colour, however, disappears on descending, and after a few feet, passes into blue, when the rock approaches the form of trappite, but appears to be more compact and less crystalline. The calcspar is sometimes in veins, sometimes in small crystalline masses forming part of the rock like the other ingredients, and sometimes diffused throughout its substance, only becoming visible in the way above stated; in this form it very much resembles diffused glassy felspar. The amygdaloid is not raised into hills, like the trappite, nor have I distinctly seen it overlying the latter, though it appears to be a subsequent effusion.

*Volcanic Breccia.*—This, which in the islands of Bombay and Salsette presents all the characters that heat, water, and decomposition can give to an effusion of the kind, is composed of angular fragments of sandstone and sandstone conglomerate, argillaceous shale, amygdaloid, basalt, diorite, and granitic rocks, to which may be added fragments

of the lacustrine formation; imbedded in a compact, jaspideous, granular, or cavernous, arenaceo-argillaceous, loose base; solid, unstratified, sometimes pseudo-prismatic; of a red, blue, grey, or black colour; passing, in decomposition, from the jaspideous, black, homogeneous form into a fine red clay; and from the loose, arenaceo-argillaceous, red state into a sub-granular, red, sandy earth; in both instances losing all traces of its original composition. The reason of its possessing all these characters is that it exists in the island of Bombay in the state of a breccia, and in that of a black jaspideous basaltic rock, with all the intermediate varieties and decompositions peculiar to either.

A person may walk from the red hills, where it is in a loose, friable, lateritic state, to the black hills, where it is in a jaspideous one, passing over a plain of it, which, gradually becoming more and more compact, at length assumes a darker colour, and finally, losing all heterogeneous composition, ends in a black, jaspideous, homogeneous mass. On his way, too, he will pass over parts of the surface where there is the polygonal division common to rocks which have been in a semi-fluid state, and here the fragments of which the rock is composed are most evident and striking; while the same effusion, in some parts under the trappitic crust, where it has been continually exposed to moisture, is throughout of a soft, cheesy consistence. The friable sectile state of this breccia, where it forms the red hills, is the only part where the fragments of the rocks contained in it retain any trace of their original structure and appearance, and even here the whole has undergone such alteration, that in hardness, all parts yield equally to the cutting instruments which are used to fashion it into blocks for architectural purposes. Still the structure of a conglomerate may be detected in many of these fragments, though this hardly amounts to more than the rounded cavities and black ferruginous shells of the gravelly pebbles which they formerly contained; while the various colours of the fragments, viz. deep black, red, chocolate, brick-red, violet, lilac, grey, and variegated with specks, spots, or streaks of one in a base of the other, together with a zonular arrangement in some, bear such a striking resemblance to the colours of the fine argillaceous sandstones and their nodules of the Oolitic Series, that no doubt, hardly, can be entertained of their having belonged to the latter.

At first I thought they must have come from the intertrappean lacustrine formation, for I knew little then of the characters of the sandstones and shales of the Oolitic Series, or how they were situated with respect to the trappean effusions. But since I began to reflect on the extent of the volcanic breccia in the neighbourhood of Bombay, and

remembered that the whole of the trappitic and basaltic crusts of the island are most probably underlaid by it; that it forms all the hills on the north-eastern part of the island, some of which are 130 feet high; that it also forms a great part of the mountains in the island of Salsette, and extends to its northern extremity, making in all a tract north and south of 28 miles, and probably a great deal longer, I have naturally come to the conclusion that the lacustrine formation could not have supplied all the fragments in this great mass, and that their origin must be sought from some other source. I therefore examined several of them carefully, and found what has been mentioned, but the subject deserves a much more extended investigation than I have been able to give it.

The lateritic character of this effusion, where it forms the red hills, is very striking, and a full description of it and of the effusion generally will be found in my "Geology of the Island of Bombay." Suffice it here to add, that the distinctive character of this volcanic breccia from the genuine laterite, consists in the presence of fragments of other rocks in it, as well as its position.

Dyking these red hills will be found a similar effusion, of a much lighter colour; so much so, that when fresh from wells which are being sunk in it, it serves for white-washing. This, on examination, appears to be a kind of trappitic kaolin, for if the white decomposing powder be brushed off in water, a gritty mass will remain, presenting the greenish tint and general appearance of trappite. This effusion has not only veined and burst through the trappitic crust in many places, but in one part it overlies the crust of one of the trappitic ridges, which is 100 feet high, and there, appears as a white amygdaloid, the cavities of which are filled or lined with siliceous minerals only, viz. quartz, calcedony or agate.

Many of these cavities or geodes are half as large as a man's head, and contain large crystals of colourless or amethystine quartz.

Lastly, there is an effusion, which has all the appearance of an old pisolitic pumite: it is harsh to the touch, breaks with a rough fracture, and presents the short-cut fibrous structure peculiar to pumite conglomerate. In it, too, are rounded pebbles of the so-called white trap to which I have before alluded, with its vesicular cavities filled with decomposed laumonite and general calcareous impregnation, besides fragments of other rocks belonging to the trappean effusions. I have only seen a few specimens of this, of a blue colour, which were picked up by Dr. Leith in the island of Salsette, where they were mending the roads with it. This is decidedly the nearest approach to modern

volcanic effusions that has come under my notice in the neighbourhood of the island of Bombay.

There is a fac-simile of it in a stratum at Aden some way up the base of the mountain, in Back-bay, but there it still retains the lightness, freshness, and looseness of structure indicative of more recent origin, while that of Salsette is heavy and consolidated, and, therefore, more nearly approaches trachyte.

All these effusions in the island of Bombay appear to have undergone elevation since they were ejected; they have a more or less sloping and a scarped side, the former presenting towards the east, the latter to the west.

The fragments of the sedimentary rocks in the volcanic breccias of the Rajmahal hills, and those in the trappean effusion on the Pennar, mentioned by Malcolmson, all appear to retain much more of their original structure, elementary composition, and appearance, than those in the volcanic breccia of Bombay; yet a large angular fragment of a granitic rock, found by Dr. Leith in the transitionary part of the volcanic breccia of the black jaspideous hills, still retains its original whiteness, and vindicates its right to a place among rocks, which, however near the surface of the great trappean district in the island of Bombay, are not found *on* it for hundreds of miles all round.

In his sketch of the geology of the "Bombay Islands" Dr. Thomson seems to have applied the name of porphyry to the volcanic breccia; but I have seen none of it which merits this appellation, though I should mention, that on comparing some blocks of red porphyry that were brought from Jiddah with the decomposed red breccia of the hills at the north-eastern extremity of the island of Bombay, and of others in Salsette, the two appear to be identical, but for the decomposition of the latter. The compact red paste, throughout which are disseminated small, white, well-defined crystals of felspar, with here and there fragments of other rocks, in the Arabian porphyry, (*Porphyre antique*, Brongniart,) appear to find their exact representatives in the red, loose, arenaceo-argillaceous base of the volcanic breccia of Bombay, with its white specks and spots corresponding to the felspar, and its fragments of other rocks, all of which seem merely to want general consolidation and crystallization to make the whole mass identical with the prophyry from Jiddah.

In this series of trappean effusions, masses of heliotrope and jasper appear not to be uncommon. A large block of the former was met with in tunnelling for the Bombay railroad through a low trappean ridge on the mainland, opposite the town of Tanna. The heliotrope

of the Cambay ornaments comes from a hill near Rajcote in Kattyawar, and at the village of Tullajah, in the same province, which is about 20 miles south of Gogah, there is a hill, composed of basalt below, laterite above, and on the top of all, a rock "like a large mass of bloodstone" (Fulljames). The heliotrope and jasper of the trappean effusions generally appear to me to be derived from fragments or masses of sedimentary rock with which the igneous ones have come in contact, or have enveloped when in a semi-fluid or incandescent state.

There are still more recent traces of volcanic outbursts in Cutch and India, but it will be more convenient to allude to these hereafter.

## XI.

### Miocene and Pliocene Formations.

Hitherto we have been viewing the geological formations of different epochs in India in detached masses and tracts, without much reference to their continuity, and none at all as to the parts which were deposited in deep or shallow water, or to the deposits of lakes, rivers, or estuaries, which may have been contemporaneous with these formations; nor, in the present state of our knowledge, is it possible to do otherwise: at the same time it must be obvious, that however much their mineralogical characters may aid in the commencement of this investigation, nothing but an acquaintance with their organic remains in the end, can enable us to determine with accuracy the boundaries and depths of the seas, lakes, rivers, or estuaries in which they were respectively deposited; or to place them in that part of the geological series to which they properly belong.

With the formations, however, which we are now about to consider, the matter is somewhat different; for their modern and fresh appearance, together with their comparatively undisturbed and unaltered state, will enable us to recognize and trace them, as a group, almost wherever they exist, without the presence of fossils; but when we come to separate these, also, according to their geological ages, the same impossibility of doing so without an acquaintance with their respective organic remains will be experienced, as in the classification of the formations which have preceded them.

Unfortunately with the miocene and pliocene, as with the older formations in India, very few of their fossils have been described; and while this arises from scarcity in the latter, it, perhaps, arises somewhat from their abundance in the former, which, with their freshness in appearance, renders them so much like the shells now on the sea shore,

that a collection or record of them seems useless and insignificant; and this impression is likely to remain so long as we are unacquainted with the great thickness of their strata, and the great and extensive changes which the earth's surface has undergone since the most recent of them were deposited. But when this is known to us, their antiquity becomes apparent, and the many thousands of species, including whole genera, that must have become extinct during the time that has been required for their formation, points out to us the necessity of making the collections of their organic remains to determine the relative ages of their different deposits, which before seemed so useless and unimportant. Indeed, it matters little about the freshness of shells, or their resemblance to species of the present day; a knowledge of those which actually exist on the coast that is bordered by these formations is as indispensable as that of those which exist in them in a state of fossilization, when we come to determine the geological age of the latter. Collections, therefore, of shells and fossils of all localities, however common and apparently insignificant, are as necessary, in a geological point of view, as the most uncommon and curious of the oldest strata on the surface of the globe.

With this short introduction to the miocene and pliocene formations, which have been placed together, at present, for want of data to divide them satisfactorily, let us endeavour, by the aid of the scanty knowledge we possess of their fossils, their mineralogical characters, position and resemblances, to draw parallels between their different deposits in different localities, and thus, by establishing their contemporaneousness, group them and place them provisionally in the divisions of the geological series to which they appear to belong. In doing which, in the present state of our knowledge, it will be necessary to go beyond the prescribed limits of the tract proposed for consideration, and to extend our observations, for comparison, to these formations on the western side of the Indus and the shores of Arabia which are nearest to Western India.

## Miocene Formation.

*Solid, coarse, shelly and coralline Limestone. Oyster-beds. Calcareous, argillaceous, quartzose or sandy Conglomerates. Ossiferous Conglomerates. Lower Blue Clay.*

In the southern part of Cutch, the western part of Kattyawar, and the South-east Coast of Arabia, where there have been no rivers of any consequence to interrupt, by their transported matter, the continued deposit of the marine exuviæ and rolled detritus of these localities, the miocene formation is much the same. Thus, in Cutch it is stated by

Grant to consist of a hard argillaceous grit, interspersed with fossil shells. At the village of Soomrow, it is a "hard, compact, calcareous rock, full of shells, and burnt for lime; and below this rock is a coralline limestone." The former contains oysters near Eyeraio. These deposits "abut against the nummulitic beds"; but their thickness is not mentioned.

I am also informed by Lieutenant Constable, I. N., who has just been engaged in surveying the Western Coast of Kattyawar, that the whole of this coast is cliffless, and raised but a few feet above the level of the sea, which (by the specimens) throughout, breaks upon a compact, gritty limestone of a yellowish colour, raised here and there, a little inland, into mounds and hills, varying in height from 50 to 100 feet; on the top of one of these is a bed of oysters impacted in the rock. From the specimens of this limestone which Lieutenant Constable kindly brought me, with careful descriptions of the places from which they were taken, it evidently possesses the same characters as the compact calcareous rock of the miocene deposits on the South-eastern Coast of Arabia, and, therefore, is probably identical in formation with it and that of Cutch. But it is only on the coast of Arabia that I have had a good view of this formation, from which the following section, from above downwards, was carefully taken:—

| | | |
|---|---|---|
| Compact, coarse, shelly limestone, of a white colour, argillaceous. | 20 | feet. |
| Compact, coarse limestone, of a reddish-white colour, chiefly composed of gravel from the older limestone of the neighbourhood, in an argillaceo-calcareous cement | 7 | „ |
| Compact, coarse, shelly and coralline limestone, of a greenish, reddish-white colour, argillaceous; (bivalves and ostreæ) | 6 | „ |
| A bed of large, thick oyster shells, in a coarse, compact limestone cement | 1½ | „ |
| Large, rounded, white limestone pebbles, in a compact, coarse limestone cement | 2½ | „ |
| Coarse, compact limestone, of a smoky-brown colour, containing more or less of the neighbouring rocks in the state of rounded gravel; *remarkable for its cragginess where exposed to the action of the waves* | 10½ | „ |

This formation rests on the older limestone or igneous rocks of the locality, and constitutes the inferior two-thirds of a small cliff, which is continuous for many miles along the middle of the South-east Coast of Arabia, resting on the base of the scarped table-land which here slopes into the sea. Its strata dip slightly towards the latter, and throughout it is capped by the pliocene formation, which will hereafter be described.

The few fossils which I obtained from it belong chiefly to the family *Ostracea*, and they closely resemble those in Tab. xxv. of "Grant's Geology of Cutch." But near the village of Takah, in the upper part of the cliff, probably in the upper stratum of the above section, *Orbitolites* and *Orbitoides* abound. This, when I was writing a geological sketch of the coast, appeared to be a great anomaly, for I had thought, from seeing these fossils so frequently associated with nummulites, that this deposit must be a part of the eocene formation, which in some way or other had interrupted the continuation of the cliff; yet the same parallelism and lines of stratification of the latter being equally continuous at this as at any other part, and the brown limestone rock underlying all, as usual, though the cliff (about 100 feet high) had fallen forward in great rectangular masses into the sea, left me still in doubt as to the soundness of the conjecture. Now, however, this no longer exists, for specimens of this formation, brought from the coast of Kattyawar by Lieutenant Constable, also abound in *Orbitolites*, both plane (papyraceous) and convex. This, again, throws a doubt over the nature of the formation from which the specimens of limestone in the Rajpeepla hills, sent me by Major Fulljames, came, and which I have before set down provisionally, as part of the Nummulitic Series, from their containing *Orbitolites;* but the whole rock bears such a striking resemblance to the miocene formation, that it now seems to me more probable that it, also, should belong to this, rather than to the Nummulitic Series. Lastly, the occurrence of numbers of *Orbitolites* in another form of this tertiary deposit on the southern part of the Malabar Coast, which will presently be mentioned, sets the question at rest, in my own mind, respecting the formation to which the stratum on the Arabian coast containing these fossils belongs, viz. to the miocene, and not to the nummulitic deposits.

The extreme cragginess of the lowest stratum of this series, where it has been exposed to the action of the waves, characterizes it not only on the South-east Coast of Arabia, but on that of Kattyawar, and, apparently, even in the Laccadive Islands, judging from rock-specimens of the latter which were presented to the Society by Captain Moresby, who surveyed them. It is difficult to account for this peculiar cragginess, unless it be owing to the more perishable nature of the portions of the older limestone rocks (which here and there form a great part of this deposit) yielding to the fretting and dissolving action of the waves, and thus leaving the cement which held them together in the peculiar form mentioned. But to whatever cause it is to be attributed, the rugged appearance of this rock, where exposed to the waves, is very

striking. Its geological age, probably, as well as its composition, induces this peculiarity.

The following descriptions of fossils illustrating this formation in Grant's "Geology of Cutch," have been given by Mr. J. deC. Sowerby :—

"*Clypeaster oblongus. (C. scutiformis?* Lam.)—Oblong, subpentagonal, convex above, concave beneath ; ambulacra very broad, obtuse. Length 2¾ inches, breadth above 2 inches, height 7 lines.

"*Clypeaster depressus.*—Pentagonal ; much depressed ; ambulacra oval ; anus very near the margin. Length in the oldest individual about 2 inches, breadth rather less, height about ½ inch.

"This differs from *C. Laganum* in the position of the anus, which in that species is half-way between the mouth and the margin, in the greater size of the papillæ, and in being much thinner.

"*Serpula? recta.*—An oval, free, slightly waved shelly tube, which we have provisionally called a *Serpula*, although it is more like the tube of a *Teredo* ; but it appears to have been formed in loose sand. Diameter ¾ inch.

"*Siliquaria Grantii.*—Spirally striated, striæ crossed by numerous cracks ; fissure composed of a series of oval pores. It differs from the recent *S. anguina* only in the smallness of the pores which form the fissure.

"*Balanus sublævis.*—Sub-cylindrical, with curved valves ; nearly smooth operculum ; diameter 1 inch, height 9 lines. Parasitic upon shells.

"*Corbula trigonalis.*—Trigonal, with the front rounded, gibbose, antiquated ; valves nearly equal ; posterior side truncated obliquely, with a carina upon each valve, and pointed ; umbones equal, central. Length 6 lines, width 8 lines ; but these proportions vary.

"*Corbula rugosa.* (Lam. vol. v. p. 497.)—This differs from the last in being a much wider shell, with more regular and prominent laminæ upon the surface. Length 2½ lines, width 3½ lines.

"*Tellina exarata.*—Ovate, compressed ; ornamented with many erect concentric laminæ ; the posterior extremity pointed, much bent. Length nearly three-fourths of the width, which is nearly 2 inches. Strongly resembling *T. virgata*, (Lam. Hist. Nat. vol. v. p. 52,) but wider, and more bent.

"*Venus granosa.*—Obovate, truncated, posteriorly convex ; ornamented with erect concentric laminæ ; crossed by numerous striæ, which cut these (near the margin) into rounded grains ; lunette broad, pointed, convex ; beaks nearest the anterior extremity. Length 1¾ inch, width more than 2 inches.

"This belongs to the same family of *Venus* as *V. corbis*, and *V. puerpera*, and is scarcely distinguishable from *V. puerpera.* β (Lam. Hist. Nat. vol. v. p. 585.)

"*Venus cancellata.*—Obovate, approaching orbicular, gibbose ; ornamented with erect concentric laminæ, and many longitudinal striæ ; lunette wide pointed, convex ; beaks nearest the anterior extremity. Length 1¾ inch, width 1 inch 11 lines.

"This resembles the last, except that it is rounder, with thinner laminæ, which are not cut into round grains.

"*Venus non-scripta.*—Transversely oval, convex, smooth, concentrically undulated ; lunette elongated, pointed, concave ; beaks near the anterior extremity.

Length 1 inch 4 lines, width 1¾ inch. A smooth and thin shell, with little of the aspect of a *Venus*.

"*Pullastra? virgata.*—Transversely oval, elongated; decorated with smooth concentric ridges; beaks nearest the anterior extremity. Length 13 lines, width 1 inch 7 lines.

"Several recent species of *Pullastra* are like this, but no described one appears to be identical with it.

"*Cardita intermedia?* (Lam. Hist. Nat. vol. v. part i. p. 23; Brocchi, vol. ii. 520, t. 12, f. 15.)—This strongly resembles several species of *Venericardia*. (Lam.)

"*Cardium triforme.*—Orbicular, ventricose, longitudinally striated; anterior side covered with round granules, formed by decussating striæ; the posterior side crossed by oblique sets of reflected ridges. Length and width 1 inch 4 lines. Somewhat resembling the recent *C. œolicum*.

"*Arca radiata.*—Transversely elongated, oblique, rather convex, radiated; radii elevated, furrowed; beaks almost close, nearest the anterior side. Length 7 lines, width 1 inch.

"*Arca tortuosa?* (Linn.)—This is only a fragment, and what there is seems to differ from the recent *A. tortuosa* in the degree of curvature.

"*Pecten Somrowensis.*—Obovate, convex, radiated; radii about 24, squamose, subdivided in one valve into 3, in the other into 5; ears unequal, striated, and squamose. Length 2 inches 2 lines, width nearly 2 inches.

"In form this *Pecten* approaches to *P. varians*, but in the structure of the surface it is like *P. plebeius* of the crag, and many recent species.

"*Pecten articulatus.*—Orbicular, with pointed beaks, depressed, radiated; radii about 28, simple rounded, crossed by distant scales: ears large, striated, and squamose. Length in an old specimen about 1 inch 8 lines, width 1 inch 6 lines.

"*Gryphœa globosa*, (M. C. t. 392; *Ostrea vesicularis*,) Lam. Hist. Nat. vol. vi. part i. p. 219; Cuv. and Brong. Env. de Paris, 383, t. 3, f. 5; *Podopsis gryphœoides*, Lam. Hist. Nat. vol. vi. part i. p. 195.)—This exactly agrees with old specimens found in the chalk of Norfolk.

"*Ostrea angulata.*—Sub-orbicular, arched, compressed, plaited; plaits angular, numerous, branched towards the margin; laminæ of increase regular, distant, raised at their edges. Length about 1¼ inch, width the same.

"*Ostrea flabellulum.* (M. C. t. 253; Lam. Hist. Nat. vol. vi. part i. p. 215; *Chama plicata*, Brander, 84 and 85.)—The identity of this oyster with the *O. flabellulum* of the tertiary formations of Europe is unquestionable.

"*Ostrea tubifera.*—Orbicular; laminæ of increase thick, raised into a few large, nearly erect tubes, arranged in about 6 rows. Diameter 2 inches.

"*Ostrea lingua.*—Much elongated, smooth, approaching to even; upper valve flat or concave, the other very convex; squamoso-fimbriated at the edges. Length 2½ inches, width 1½ inch.

"So variable are *Ostreæ* in form, and so much do the species resemble each other, that it is hardly possible to define some of them clearly. That before us is very like *O. tenera*, (M. C. t. 252, f. 2 and 3,) yet in the depth of the attached valve it approaches to *O. Meadii*, (M. C. t. 252, f. 1 and 4,) but is not waved like that.

"*Bulla lignaria.* (Linn.)—This agrees perfectly with the recent species, as far as

we can ascertain from specimens which are not perfect; but it is quite distinct from both the fossil shells described by Deshayes under the same name.

"*Natica obscura.*—Globose, umbilicate; spire small, pointed; whorls about 5. convex, flattened, and ornamented at the upper edge with fine diverging plaits; umbilicus partly filled with a semi-cylindrical, obliquely truncated callus. Height 1¼ inch, diameter the same.

"Nearly related to *N. Epiglottina* (Lam.), but distinguished by the flattened upper margins of the whorls; and to *Nerita canrena* of Brocchi (vol. ii. 296).

"*Natica callosa.*—Obliquely depressed; spire small, hardly projecting; umbilicus covered by the thickened and expanded inner lip; aperture very large. Height 2 inches, diameter 1⅝ inch. A very distinct species.

"*Globulus? anguliferus.*—Oblong, obliquely striated; spire produced; whorls about 4, with their sides and upper edge flattened; umbilicus open, rather large. Height and diameter ⅝ inch.

"The elevated lines or striæ advancing towards the aperture as they descend the sides of the whorls, form a peculiar character. The aperture appears to be small.

"*Solarium affine.*—Convex above, flattish beneath, marked with diverging striæ on both sides; whorls 4 or 5, with a deflected entire carina, above which are 4 furrows, placed at nearly equal distances, and below, 2 furrows near the carina, and 2 near the umbilicus, which is large, with a crenated edge. Diameter 1½ inch, height ½ inch. Perfectly distinct from *S. perspectivum*, which it somewhat resembles.

"*Trochus cognatus.*—Conical, with straight sides; whorls numerous; ornamented with several rows of granules, which sometimes (especially towards the apex) are united by elevated lines, and a row of tubercles upon the inferior edges of the upper whorls, succeeded by 2 rows upon the middle volutions, and crenated ridges of slight elevation on the rounded border of the lowest whorls; base flat, concentrically furrowed, containing a thick plait within.

"Like *T. maculatus.* Height 2 inches, diameter of the base nearly the same.

"*Turritella angulata.*—Turrited, conical; whorls convex, decorated by about 7 carinæ, of which the lowest but one is much the most prominent. Height 1½ inch, diameter 8 lines.

"*Turritella assimilis.*—Turrited; whorls convex, ornamented with 6 or 7 carinæ, of which 2 or 3 are obscure, the 2nd and 5th being prominent. Height 1½ inch, diameter 5 lines. A smaller, narrower species than the last.

"*Terebra reticulata.*—Subulate; sides of the whorls flat, cancellated; a narrow upper portion of each whorl divided from the lower in the form of a band by a ridge and furrow; beak short, curved.

"In some specimens the transverse or spiral lines are less conspicuous, particularly on the band, and the upper half of the whorl.

"*Cerithium rude.*—Subulate, with curved sides, ribbed and furrowed; ribs numerous, cut across by about 5 square furrows, of which the uppermost is distant from the suture; whorls 10 or 12, nearly flat, with an obtuse varix between each; the last varix very prominent; aperture nearly round, with a canal at the upper angle; inner lip thick, with a callus at the top; beak broken. Height 2 inches 8 lines, diameter about 8 lines.

"*Cerithium corrugatum.*—Subulate, ribbed, and coarsely striated; ribs

numerous, arched, and prominent, crossed by deep striæ; whorls 8 or more, rather convex, with a distinct varix upon each.

"This has much of the contour of an elongated *Fusus*. The lip and beak are wanting in the only specimen found.

"*Fusus? granosus.*—Short, fusiform, ribbed; ribs about 12 upon each whorl, divided into grains by 6 or 7 transverse ridges; convex; spire half the length of the shell; beak suddenly contracted. Height 4 lines.

"A pretty shell, much resembling some species of *Nassa* which occur in the crag.

"*Fusus lævisculus.*—Short, fusiform, ribbed, and striated; ribs irregular, mostly very short; whorls 6, angular; base conical; beak short. Height 10 lines, diameter 5 lines.

"*Fusus nodulosus.*—Fusiform, elongated, ribbed, and strongly striated; ribs short, broad, about 8 in the middle of each whorl; whorls 6 or 7, concave above, convex below; beak contracted.

"*Fusus (Murex?) hexagonus.*—Short, conical, with an elongated beak, 6 angled; whorls about 6, with 6 ribs on each, which form the angles of the spire, and are crossed by 3 strong ridges upon the spire, thickened where they cross; convex; beak suddenly contracted.

"*Ranella bufo.*—Conical, with 2 rows of thin expanded varices, and several ribs, the whole crossed by 3 or 4 prominent and several intermediate thin ridges; whorls 7 or 8, convex; varices obtuse at their edges; aperture oval; beak short, obliquc. Height 1 inch 4 lines, diameter 1 inch. Nearly resembles *R. bituberculata* of Lamarck.

"*Rostellaria rectirostris.* (Lam. Hist. Nat. vol. vii. p. 192.)—The elongated form induced us to refer this fossil to the recent *R. rectirostris*, in preference to any other species.

"*Strombus deperditus.*—Turbinate, tuberculated, and transversely striated; tubercles united by a slight carina, gradually increasing in size; lip thickened, produced above into a short pointed lobe. Height 2¼ inches, diameter 1 inch 4 lines, including the wing.

"*Strombus nodosus.*—Turbinate, elongated, tuberculated, transversely and longitudinally striated; tubercles equal, numerous, prominent, obtuse. Height 1¾ inches. Distinguished by the rounded tubercles, of which there are about 12 to each whorl and the elongated spire.

"Rare: we have seen but one specimen, and that is very imperfect.

"*Cassis. (Cypræcassis,* Stutchbury.)—Sculpta ovate, transversely sulcated; aperture narrow, the outer lip plaited, the inner smooth. Height 1¾ inch, diameter 1 inch. Strongly resembling *Cassis (Cypræcassis,* Stutchbury,) *Testiculus, (Bucc. Testiculus,* Linn.) but smoother, and with a narrower aperture.

"*Turbinellus affinis.*—Sub-fusiform, swelled in the middle; ornamented with many transverse ridges, and a row of flattened tubercles near the upper margin of each whorl; beak produced transversely, ribbed; columella 5-plaited. Height 4 inches, width 2 inches.

"Very nearly related to *T. Scolymus* (Lam.), but it is more elongated, has smaller tubercles, and 5 not 3 plaits on the columella.

"*Mitra scrobiculata?* (Brocchi, vol. ii. p. 317, t. 4, f. 3.)—This is the same as the fossil found at Piacenza. It is often larger than our figure.

"*Mitra fusiformis.*—Fusiform, pointed, striated; striæ distant, deep, punctated; suture entire; columella with 4 plaits. Height 2 inches, diameter 9½ lines.

"*Volupta jugosa.*—Fusiform, pointed, transversely striated; costated; costæ many, rounded, terminating in points above the suture; aperture elliptical, elongated; columella with 3 plaits. Height 2½ inches, diameter 1¼ inch.

"This differs from *V. Magorum* of Brocchi, in the form of the ribs, and the small number of plaits upon the columella, and from *V. costata* (M. C. t. 290,) in the form, and in the greater number of the ribs.

"*Voluta dentata.*—Turbinate, striated; spire short, conical, pointed; whorls crowned with tubercles, which surround a concave space; aperture elongated; the outer lip thick, crenato-dentated within. Height 1 inch 7 lines, diameter 1 inch.

"*Cypræa humerosa.*—Obovate, depressed with 3 protuberances upon the back, and one on each side. Length 2 inches, width 1½ inch.

"*Cypræa Prunum.*—Oval, ventricose; aperture narrow, slightly curved, with about 20 teeth on each side; base convex; beak small, not much produced; a very even shell. Length nearly 2 inches, width 1¼ inch.

"*Cypræa digona.*—Ovate, ventricose, slightly depressed; base flattened on each side; beak expanded, prominent, with sharp edges; teeth on each side the aperture, above 20. An obscurely marked species. Length 13 lines, width 9½ lines.

"*Cypræa nasuta.*—Ovate, elongated, ventricose; beak projecting, large; posterior extremity of the lip produced; apex of the spire sunk. Length 10 lines, width 6 lines.

"*Terebellum obtusum.*—Ovate, much elongated; spire 2 or 3 whorls, obtuse. Length about 2 inches, width 6 lines.

"This is more like the recent *T. subulatum* than the fossil *T. fusiforme.*

"*Oliva Pupa.*—Elongated, sub-cylindrical, with a produced, pointed spire, a broad smooth band at the base, and a slightly plaited callus on the columella. Length 1 inch 9 lines, width 8 lines.

"*Conus brevis.*—Short, conical; spire flat; with a produced apex, marked with 4 concentric striæ, decussated by the lines of growth; base ornamented with several small, rather distant ridges. Height 1¼ inch, diameter 1 inch.

"*Conus militaris.*—Conical, elongated, slightly contracted towards the edge of the spire; coloured by many triangular spots, arranged in zigzag rows; spire flat; upper surfaces of the volutions concave; base nearly smooth. Height 1½ inch, diameter 11 lines.

"This shell, and the following, retain traces in a remarkable manner of the original colouring.

"*Conus catenulatus.*—Conical, elongated; coloured with transverse rows of white spots upon a dark ground; spire flat, elevated in the middle, concentrically striated, mottled with white, the edge sharp; the base obscurely furrowed. Length 1¼ inch, width 8 lines.

"*Conus marginatus.*—Conical, much elongated; spire conical, short, surrounded by an obstuse ridge from its base to its apex; base of the shell striated. Length 1½ inch, width 8 lines."

The principal part of the above fossils came from the tertiary deposits at Soomrow; the rest (11) chiefly from Kotra, and the borders of the Runn.

### *Lower Blue Clay.**

Contemporaneous and parallel with the foregoing calcareous formations is a blue clay, which appears to exist throughout the Western Coast of India, from Kurrachee to Cape Comorin, but chiefly in the neighbourhood of bays and inlets into which rivers have long been discharging themselves.

The following table will exhibit this better, perhaps, than separate descriptions of this deposit and its accompaniments, at the different places therein mentioned :—

| *Kurrachee.* | *Cutch.* | *Cambay.* | *Travancore.* |
|---|---|---|---|
| Feet. | | Feet. | Feet. |
| Blue clay, with lignite and septaria. 60 | Blue clay, with lignite; and "olive brown earth with pieces of amber or mineral resin." | Blue clay, with septaria and lignite.... 229 | Blue clay..... 4 |
| Yellow clays, sand, and conglomerates..... 24 | | (Bore at Gogah, Fulljames.) | Lignite; and mineral resin in olive brown earth ..... 18 |
| Blue clay..... 74 | Yellow marl, with lignite. | | Sandy blue clay. 3 |
| (Bore at Ghizree, Major Turner.) | (Near Baboa Hill, Grant.) | | Slabs of gritty argillaceous limestone, of a bluish-green colour, containing orbitolites, &c. with rubbly matter above and below, abounding in tertiary fossils. |

Having thus shown that the existence of this clay is general on the Western Coast of India and in Scinde, we have next to point out its contemporaneousness with the coarse limestone of Cutch, Kattyawar, and Arabia, which may be inferred from the following facts :— 1*st*.—That, like the latter, it is immediately overlaid at Kurrachee and on the coast of Travancore by the pliocene deposits which will be presently described, while, on the other hand, it forms the lowest part of the cliffs of Travancore, which probably rest on the metamorphic or granitic rocks of that locality. 2*nd*.—Near the hill called Baboa, in the western part of Cutch, which is within 10 miles of the eastern mouth of the Indus, it, with the yellow marl beneath, lies immediately on the nummulitic limestone, and is again immediately overlain by the

* This clay has been called "lower" in contradistinction to a more modern deposit of the same kind, which will hereafter come under our consideration.

same conglomerates, apparently, which are stated by Grant to overlie the calcareous parallel of this formation at the village of Soomrow, 24 miles further to the south. The difference in the nature of the deposits in these two places having probably arisen from the lesser distance of Soomrow from the sea, and its much greater distance from the Indus, than the neighbourhood of Baboa hill. *3rd.*—On the coast of Travancore the blue, argillaceous, gritty limestone, with the rubbly calcareous material on each side of it, forms the base of the blue clay and lignite deposits, and abounds in fossils that are identical with those which illustrate the tertiary formation in Grant's "Geology of Cutch," together with *Orbitolites*. Further proof is hardly wanting to establish the identity of these two formations. But the account of the cliffs on the coast of Travancore, which General Cullen has kindly sent me, is so instructive, and so much more satisfactory than anything published on the subject, that I cannot do better than give it in his own words:—

"The first well I opened was on a laterite cliff or point, 4 or 5 miles NE. of the town of Quilon. Having observed some yellowish slabs of dolomite [argillaceous limestone?] at the base of the cliff or strand of the back-water, which there suddenly deepens to 40 feet, and, therefore, prevented my tracing it further downwards, I laid open several feet of the face of the cliff, and, still finding the dolomite slabs apparently passing under it, I then went above, for about 100 feet inland, and there sunk a large well, and met with the dolomite at the depth of about 38 feet.

"I then ascertained that the dolomite appeared everywhere to prevail below the laterite round Quilon, at a depth of about 40 feet from the surface.

"This was determined by the examination of wells in different localities, and by further sinking several which had not been carried down to that depth.

"I think there was a loose rubbly bed or stratum, of exactly the same composition as the compact limestone, both above and below the slabs, and in which the greater number of the organic remains were found; but the limestone itself (though extremely hard and tough) also contained numerous specimens, in the most perfect state of preservation. The limestone is of a bluish-grey inside, but externally, where exposed to the weather, of a dull yellowish colour.

"The laterite and lignite cliffs of Varkalay, which are also near Quilon, that is about 12 or 14 miles south, extend along the coast,

about 6 miles, varying in altitude from 40 to 60 feet. Below the laterite is a series of beds of very beautifully variegated coloured sands and clays, and below them, again, the carbonaceous clays or shales and lignites. At the north end of the cliffs, where they are only 80 feet high, the lignite bed is level with the beach; but to the south, where the cliffs attain an altitude of 140 feet, there appear to be 3 or 4 successive deposits of lignite, each of which is from 4 to 6 or 8 feet thick. To ascertain, also, if this lignite bed extended inland, I sunk a well 20 feet in diameter, at a distance of about 100 yards from the cliff, and after passing through 22 feet of laterite only (because the well was here sunk in a hollow) came to the lignite clays. I then sunk a small well, about 5 feet in diameter, on one side of the large one, to determine the thickness of the lignite bed, which was penetrated after 7 feet, meeting then with a bed of loose, white sand, from which the water immediately sprung up so rapidly as to oblige the people to leave off working. I have not found any traces of organic remains in these cliffs, nor any traces of limestone. The carbonaceous lignite beds abound with resin and iron pyrites (white), both in lumps of considerable size. I have a lump of the resin 10 inches in diameter.

"The variegated coloured sands that I have spoken of as lying between the laterite and lignite beds are exceedingly beautiful—at least fifteen different and perfectly distinct tints. It has strongly reminded me of what I have often heard, but never seen, except in geological drawings, viz. the strata of Alum Bay, in the Isle of Wight.

"Plumbago and graphite, in small thin scales, abound in the gneiss and granite both of Travancore and Tinnevelly, and of course also in the laterite; sometimes in the latter in great profusion."

These observations furnish us with two important facts, of which one has been mentioned, viz. the existence of tertiary fossils (miocene) below the blue clay and lignite; which is also pointed out in another part of General Cullen's letter, and further confirmed by the identity of several specimens of a small collection which he kindly sent me from these beds, with the tertiary shells of Cutch figured by Sowerby in Grant's geology of that province. The specimens of the limestone, too, which General Cullen formerly presented to the Society through Dr. Buist, not only bear the colour of the clay, but, with its imbedded tertiary shells, also contain portions of lignite, indicating its intimate connection with it. The other fact is, that this limestone, clay, and lignite, underlie the lateritic deposits. General Cullen is also of opinion that the laterite consists of *debris* of the older rocks of the neighbourhood; and the whole, as before stated, probably rests on

the granitic and metamorphic rocks of the coast of Travancore, for there appears to be no other in this part of India, at all events inland.

On the other side of the Ghauts, however, the matter is different, for General Cullen states:—

"On the Tinnevelly side are also granite and gneiss, but, in the low country, crystalline limestones and sandstones, as well as others of the above rocks towards the sea coast, containing organic remains." This is worth remembering, because the lateritic deposits of the Coromandel Coast will probably be found to have been formed as much from the *debris* of their neighbouring rocks as the lateritic deposits of the Malabar Coast have been formed from the rocks in their vicinity.

The following is a condensed section of two bores on the Coromandel Coast, made at Madras in October and November 1832 (Newbold) :—

| | |
|---|---|
| Sand and clay alternating | 13 feet. |
| Black clay | 20 „ |
| Blue arenaceo-calcareous clay | 12½ „ |
| Granitic gravel | 10 „ |
| Granite | —— |

The presumptive evidence, then, (when we remember the thickness of the lateritic deposits overlying the blue clay on the coast of Travancore,) that the lateritic conglomerate forming the low undulating ground called the "Red Hills," which run parallel with the coast north of Madras, and the "Red Hills" which are in a similar position a short distance inland from Pondicherry, has been derived from similar sources, and formed in a similar way, is very great; but to the consideration of this we shall come by-and-bye. Let us now return for a few moments to the blue clay, which, by the above section, would appear to exist on the Eastern as well as on the Western Coast of India.

I have already cited reasons for considering the lower blue clay contemporaneous in deposit with the coarse calcareous beds of Arabia, Cutch, and Kattyawar; and the identity between the deposits of this clay at the different places mentioned in the table, p. 300, seems, with its position, &c. to be established by the following facts, viz. that at Kurrachee it contains lignite and septaria, also capsules of chara (five-striated, similar to that now growing in the tanks of Bombay); in Cutch lignite and mineral resin; at Gogah in Cambay septaria; and, on the coast of Travancore, lignite and mineral resin;—while on the Coromandel Coast, the similarity of the blue clay at Madras, in relative position and general characters, to that on the coast of Travancore, although it appears to be unaccompanied by lignite and limestone, yet seems sufficient in itself to establish also their identity.

### *Ossiferous Conglomerate.*

Of the same period as the two foregoing formations, viz. the coarse shelly limestone and the lower blue clay, appears to be the ossiferous conglomerate, which is characterized by its number of mammalian and reptilian remains, together with more or less silicified wood.

This conglomerate forms part of the capping of a little island in the Gulf of Cambay, called "Perim," which is opposite the mouth of the Nerbudda. It exists, also, in the tributaries to the upper part of the Nerbudda, and in the valley of the Nerbudda itself; also in the Godavery and Payne Gunga; in the bed of the Jumna, in the Doab; and over a great part of Upper Scinde on the western side of the Indus.

The following is a tabular view of its relative position with respect to other formations in these parts respectively:—

| *Perim Island.* | *Burman Ghaut, Nerbudda.* | *Godavery, near Aurungabad.* | *Jumna, Doab.* | *Scinde, Gauj River.* |
|---|---|---|---|---|
| Feet. | Feet. | Feet. | Feet. | Feet. |
| Yellow conglomerate, alternating with sandy clay, containing bones of mammalia and reptiles; together with silicified wood, perforated by the *Teredo*, and infiltrated with calc spar ..... 21 | Calcareous conglomerate. ..... 42 | Alluvial deposits..... 40 | Alluvial deposits, and beds of concretionary limestone, (travertin or kunkur.)..... 100 to 150 | Clays and sandstone. 150 |
| | Bones of mammalia and reptiles. (Spilsbury.) | Silt ..... 3 | | Upper bone-bed.... 60 |
| | *Omer Nuddi.* | Pebble-beds, containing bones of extinct elephant..... 4 | Clay-bed, and bones of mammalia. | Sandstone and many fossils ..... 60 |
| | Regur ..... 3 | Trachyte. | | Lower bone-bed. Marly clays, with *Turritella* (arenaceo-calcareous rock of Kurachee). |
| | Yellow friable loam, with layers of calcareous conglomerates, containing fossil bones ..... 30 to 80 | | | |
| (Ethersey.) | (Nicols.) | (Bradley.) | (Smith.) | (Vicary.) |

From this table, it will be observed that the ossiferous conglomerate in the Omer Nuddi, the Godavery, Jumna, and of Scinde, is covered by a great thickness of superficial deposits, and hence, from the great time required for their formation, I am inclined to place it, for the present, in the same group with the coarse shelly limestone and lower blue clay.

At the island of Perim, it is composed of a quartz-grit, clayey base, of a yellowish colour, imbedding rounded fragments of argillaceous strata, but never any evident portions of the trappean rocks that I have seen; and at its lower part, fragments of the skeletons of mastodons, elephants, and, indeed, species of most of the larger forms of extinct mammalia, together with those of chelonian and crocodilian reptiles. There is also a considerable quantity of silicified wood present, all the portions of which, so far as I have seen, appear to have been thoroughly perforated by the *Teredo*, and worn at the ends as if they had been long floating and washed about in water before they were deposited. Portions of the bones are also rounded by attrition.

There appears to be this difference, which it is as well to remark here, between the vegetable remains of the blue clay and those of the quartzose or gravelly conglomerates, viz. that in the former they are carbonized, and in the latter silicified.

Perim island, which is situated on the Eastern Coast of Kattyawar, opposite the mouth of the Nerbudda, appears to be nothing more than a disconnected portion of the mainland, from which it is separated by a deep channel, which is about 1,200 yards in width. The island is 1,300 yards long, and 500 yards broad, and its highest part is 21 feet above the level of the sea. Of this portion Captain Ethersey, who surveyed it, gives the following section from above downwards :—

| | | |
|---|---|---|
| "Reddish mould or rubbish | 3 | 0 feet. |
| "Yellow pudding-stone | 1 | 6 ,, |
| "Sandy clay | 1 | 0 ,, |
| "Dark-coloured pudding-stone | 0 | 6 ,, |
| "Sandy clay | 4 | 0 ,, |
| "Yellow pudding-stone | 1 | 0 ,, |
| "Sandy clay | 0 | 6 ,, |
| "Recent sandstone | 0 | 6 ,, |
| "Sandy clay | 8 | 0 ,, |
| "Yellow pudding-stone | 1 | 2 ,, |
| | 21 | 2 feet." |

In the lower "pudding-stone," or conglomerate, the fragments of bones and fossil wood are chiefly found.

One of the most remarkable features about this island is the depth

of water that surrounds it. The channel between it and the mainland is from 180 to 360 feet deep, and on its outer or eastern side from 198 to 1,060 feet; so that since the deposits took place which form the island, they have not only been partially raised above the level of the sea, but the great subterranean shock has occurred, which produced these immense fissures, and thus isolated the part forming Perim from the mainland of Kattyawar. On many parts of the latter, too, opposite Perim island, a similar ossiferous conglomerate exists.

It was seen by Major Fulljames in several places between Gopanah Point and Gogah, as well as some distance inland, and on the road from the latter place to Rajcote by the Rev. Dr. Wilson. Major Fulljames alludes to an interruption of its continuity by trappean rocks, but does not state whether this has taken place since it was deposited. The small capping of deposits over the ossiferous conglomerate in Perim island may be from the early elevation of this part of the formation above the level of the sea, or, if they were ever thicker, from subsequent denudation.

What river brought the materials of this conglomerate to the coast is of course unknown, but it is not unreasonable to infer, from its position opposite to, and only 15 miles from, the mouth of the Nerbudda, which is the largest river of Western India, that it was brought down by this river; especially when we connect the existence of similar animal remains, in abundance, in the valley and tributaries of the upper part of it.

There are two kinds of fossilized bones in the valley of the Nerbudda, both of which are completely deprived of their animal matter, but one is almost friable, white, and calcareous; while the other is tough, of a dark brown colour, and siliceous. Captain Vicary has also noticed this in Scinde, for in describing an escarpment at the Rund pass, on the Maulmaree river, he states:—

"In the *debris* at the base of the cliff, I found some fossil bones, evidently disengaged from the arenaceous rock above, as they differ greatly from the fossil bones usually found in Scinde, which for the most part owe their hardness to hydrate of iron. The bones found here are soft, and with a calcareous infiltration."—The remains of the extinct species of elephant found in the banks of the Godavery, and sent to the Society's museum by Dr Bradley, are in the same state; but those of the island of Perim are all hard, brown, and siliceous. If we were to see fossil shells in these two conditions, we should say that the soft friable ones were deposited at a much later date than the others. Can this be the case with these two kinds of fossil bones? The

great tusk of an extinct species of elephant seen by Mr. Dean in the bed of the Jumna, those by Captain Nicolls in the neighbourhood of Saugor, and those by Dr. Bradley in the Godavery, were all of the white friable kind, while the remains of tusks from the island of Perim are almost as hard as flint. A large collection of fossil bones which was made by Major Partridge, in the neighbourhood of Sehwan, in Scinde, and which he kindly allowed me to inspect, were, in appearance, so like those of the same species found on the island of Perim, crocodiles and mammals, that had I not known from whence they came, I should have set them all down as Perim fossils.

I do not know of any published or private section of the Nerbudda or its tributaries, where the conglomerate containing the fossil bones is seen to rest on the older rock; neither does the clay in which those bones were found by Captain Smith in the bed of the Jumna appear to be the lowest of these deposits; while the conglomerate in which Dr. Bradley saw the bones of the extinct species of elephant in the banks of the Godavery rests on trachyte with large crystals of glassy felspar, and this, again, on red amygdaloid. The conglomerate of the Godavery is composed of large and small pebbles of trappean rocks, calcedony, onyx, agate, heliotrope, laterite, and obsidian, (2½ inches in diameter,) all of which, Dr. Bradley states, have a vitreous surface, as if they had been exposed, in the general mass, to great heat. But in Upper Scinde, viz. in the Deyrah valley, among the Murree and Boogtie hills, which form the south-eastern angle of the mountainous tracts on the western side of the Indus, near its confluence with the branch formed by the union of the other four great rivers, this conglomerate was seen by Captain Vicary to rest "conformably" on the nummulitic limestone; which may be a further proof of its contemporaneousness with the coarse shelly limestone and blue clay. Near the pass leading into the western extremity of this valley, he states, "These hills are interesting, from the vast quantity of fossil bones and fossil wood which has been entombed within them; both are scattered about in vast profusion, and many cart-loads of the bones could be collected from off an acre of ground.

"The wood bears the appearance of having been drifted and waterworn previous to fossilization. I noticed palms and dicotyledonous trees, one of which had a structure resembling pine; some of the stems had a diameter of 2 feet, and the quantity exposed upon a small area was truly wonderful."

The same kind of formation exists on the Sewalick hills, where its extinct fauna has been magnificently illustrated by the labours and

under the direction of Colonel Cautley and Dr. Falconer, but as both the Sub-Himalayan ranges and the mountainous parts of Upper and Lower Scinde are beyond the limits of geological description prescribed for this summary, it is not desirable to allude to the ossiferous conglomerate which they present, further than it may appear necessary for establishing the geological position and relations of this formation in India.

Cornelian Conglomerate.

There is still another conglomerate that is connected with the lower part of the Nerbudda, which, from the composition of the matrix, appears to be identical with that of Perim island—I allude to the conglomerate in which the so-called "cornelian mines" are situated.

The chief of these are about 40 miles inland, at the foot of the westernmost extremity of the Rajpeepla hills, close to the town of Ruttunpore, which is about 4 miles from the Nerbudda, on its southern side. In describing them, Dr. Copland states that the soil in which the cornelians are imbedded consists chiefly of quartz sand, reddened by iron, and a little clay. "The nodules may weigh from a few ounces to two or three pounds, and lie very close to each other, but for the most part distinct—not in strata, but scattered through the mass, and in the greatest abundance." The sand and clay in which they are imbedded is stated by Malcolmson to bear an intimate resemblance to that of the ossiferous conglomerate of Perim island. Dr. Copland, also, states, in describing the kinds of cornelians:—"I saw none of a *red* colour at the mines; some were blackish olive, like common dark flints, others somewhat lighter; and others lighter still, with a slight milky tinge." Some nodules, on being broken, showed a mixture of quartz and agate, and others, in a crust of quartz minutely crystalized on the inner surface, contained black oxide of iron, of a powdery appearance." Hematite, [heliotrope?] chiefly of the brown and green (with red spots) varieties, Mocha stones, and jaspers of various colours, are very common."

The shafts through this bed of pebbles are about 50 feet deep. Malcolmson, contrary to what Dr. Lush has stated, observes that there are trap pebbles among the rest here, as well as in the conglomerate of Perim island.

It requires but a short examination of these flints to see that they have chiefly come from the cavities of trappean rocks. Their agatoid structure for the most part, and the white dimpled crust of calcedony which here and there remains impressed on them, where the attrition to which they have been subjected has not been able to reach, are

proofs of their having been formed in cavities of volcanic rocks; while their roundness, and the minute curvilinear lines on their surfaces, are also proofs of the great friction to which they have been exposed. At first they have very much the appearance of the chalk flints of Europe, and it is not improbable that some are from a marine formation; indeed, a section of one which I possess has an organic form in it, but this is the only instance I have met with among some hundreds, and I am not quite sure that this came from the cornelian mines, though it came from that neighbourhood. Still, as this deposit appears to have been formed by the sea on one side, and the Nerbudda on the other, it is not improbable, that, like other beaches of the kind, it contains specimens of all the rocks in the surrounding country.

From its distance inland, as well as from its similarity in composition to the conglomerate of Perim island, it appears to have been an early formation, and, therefore, probably belongs to the miocene deposits.

If any inference may be drawn from the position of the cavernous trappean rock in the island of Bombay, which is more or less filled with large bullous cavities and agates, those of the cornelian mines must have come from some of the latest trappean effusions. Be this as it may, these cavernous rocks, when exposed to the air, appear to undergo rapid disintegration. Colonel Grant mentions one place in Cutch where "the sides of the hills (of amygdaloid) are covered with heaps of rock-crystal, as if cart-loads had been purposely thrown down"; and in many parts of the great trappean district, the surface is strewed with a profusion of agatoid flints, onyx, hollow spheroids of quartz crystals, and zeolitic minerals. Do such rocks, containing these minerals, form a part of the lower or earlier trappean effusions? It would be useful to determine.

## Silicified Wood-deposit of Pondicherry.

Lastly, we have to return again to the southern part of the peninsula, to consider the nature of a silicified wood-deposit near Pondicherry, which overlies the limestone formation of that locality, already described as containing fossils referrable to the lower cretaceous and upper oolitic beds. Of this wood-deposit, Newbold has given the following description:—

"A short distance inland from Pondicherry, beds of a loose ferruginous grit rise into a low range of hills, called, from the colour of the rock, the Red Hills. They run in a NNE. direction, almost parallel with that of the coast. They are about 2 miles in breadth, and about 8 or 9 in length. The deposit, probably, extends further in a southerly

direction than the north bank of the Ariacoopang river, to which I traced it from the vicinity of Camlaput on the north. The locality where the silicified wood is found in greatest abundance is in the vicinity of Trivacary, about 15 miles west of Pondicherry. Between the Red Hills and the sea extends a plain, covered with an alluvial sandy soil, and underlying it a greyish-black or dark clayey loam, resembling that of Madras, imbedding fragments of grit and recent pelagic shells. The descent from the hills towards Pondicherry is gentle, but steeper on the western flank, where the strata have been evidently stripped off, and the subjacent fossiliferous limestones denuded, leaving a shallow valley, marking the discontinuity of the strata between this point and where the beds again appear in the vicinity of Trivacary, on the opposite or western side of the valley.

"Here they form a low broken range of hills, not rising higher than from 50 to 100 feet above the general level of the plain, having a parallel direction with the beds on the eastern side, and sloping gently towards the east. The western flank is rugged and precipitous where it meets the hornblende schiste, which flanks it to the west near the village of Trivacary. A narrow valley marks the junction line, covered with the detritus of both rocks. Here silicified trunks of trees have been imbedded in the grit in a nearly horizontal position. The stems are both straight and crooked, generally without roots or branches, though the former have been found, and the places of the insertions are frequently strongly marked on the stem. They are monocotyledonous and dicotyledonous, coniferous and non-coniferous. Dicotyledonous wood is, however, most abundant. One of the trunks I found to measure 20 feet in length, and from 1 to 2¼ feet in diameter.

"Lieutenant Warren, in the 'Asiatic Researches,' describes a trunk about 60 feet long, and from 2 to 8 feet in diameter." Another mentioned by Mr. Kaye was nearly 100 feet long. (Mad. Jl. vol. xii.)

"The imbedding rock is for the most part composed of angular grains of quartz, often stained with iron, and loosely cemented together by red and whitish clays passing into a conglomerate, and into a tabular and cellular rock, differing in no respect from some varieties of laterite. * * * The beds near Trivacary are shattered by vertical fisures."

Such is an abstract of the short description of this deposit given by Newbold, the silicified wood of which, like that in Upper Scinde, and, therefore, unlike that of Perim island, appears to bear no marks of the *Teredo*, although in conglomerates in all three places. That part near Pondicherry called the "Red Hills" will come under

the next division of the tertiary formations, for reasons which will then appear.

It may now be reasonably asked, how comes this miocene formation to immediately overlie the Pondicherry limestone, which contains fossils of the lower greensand and upper oolitic beds? And this question can only be answered by assuming that the latter must have undergone depression since it was raised above the level of the sea. For whether the upheaval of this limestone took place just after its last particles were deposited,—or whether it was after the deposit on it of the formations which occurred between this and the miocene one that now rests upon it, and these intervening portions became washed off as the whole mass rose to the surface, or during its depression,—still, in either way the Pondicherry limestone must have begun to descend at the time the silicified wood-deposit began to accumulate upon it. Could this silicified wood-deposit, which overlies a limestone close upon, if not of the oolitic period, have been contemporaneous with that of the diamond conglomerate overlying our Oolitic Series? for this series, too, might have undergone temporary subsidence for the reception of the latter,—that it also underwent great denudation previous to the deposit of the diamond conglomerate has already been noticed;—while Newbold observes, at the end of his description of the silicified wood-deposit of Pondicherry: "I am rather inclined to refer this to the freshwater chariferous limestone and chert formation than to the laterite of Pondicherry."

If the silicified wood-deposit of Pondicherry be a miocene formation, then depression of the Pondicherry limestone seems necessary for its position; while, if it be a conglomerate of the oolitic period, then it and the diamond conglomerate might have been deposited just as the Oolitic Series generally was being raised above the level of the sea. In this case, the upper beds of the Oolitic Series must have previously undergone partial dislocation and fracture, at the same time that large plains must have been left intact. For, in the first instance, we have fragments of sandstone (oolitic?) in the diamond conglomerate, and then we have the diamond conglomerate capping the hills of large districts throughout, some 1,000 feet high, near Cuddapah, where, it should also be remembered, that Dr. Heyne enumerates, among the pebbles of the diamond conglomerate, those of basalt. Further and still more precise information on this subject is much needed.

Again, Newbold remarks that "the silicified wood of the Egyptian Desert closely resembles that of Pondicherry, not only petrologically, but in *gisement*"; and certainly we cannot fail to see a great resemblance,

when we compare the relative positions of the two, assuming, from what has been before stated, that the latter is a miocene formation.

Mr. Orlebar, who was formerly Professor of Mathematics in the Elphinstone Institution of Bombay, carefully inspected the deposits in Egypt which seem to bear directly upon this point, and the following section is compiled from his account, given in vol. ii. of this Journal:—

Sand and sandstone conglomerate, with silicified trees (drift-wood).
Yellow limestone, with nummulites in the lower part, 60 feet.
White limestone, with nummulites.

Of the sandstone he states as follows:—"The structure of this rock is very various, although its sole mineral constituent is quartz. It forms the whole of the red hill near Cairo, where it may be studied with great advantage. In some parts it is a light yellow sand, in others a hard black rock, in others a conglomerate, in another a compact white quartz rock; and frequently it has a red tinge. The brown Egyptian pebbles belong to one of its conglomerate forms.

"The well known fossil trees lie in this sandstone, which is found overlying the yellow limestone throughout the desert."

Hence, when we remember Captain Vicary's statement, that the ossiferous conglomerate of Upper Scinde, which abounds in silicified wood, rests "conformably" on the nummulitic rocks in the Deyrah valley, and was probably a deposit of the Indus; that the ossiferous conglomerate of Perim island and Kattyawar also abounds with silicified wood, and was probably a deposit at the meeting of the sea and the Nerbudda; while the silicified wood of Pondicherry appears to be of the same age, and might have been a deposit of the Cauvery—we cannot help leaning to the view, that one and all, the Egyptian formation included, were deposited under similar circumstances, and about the same geological period. The comparative absence of shells, too, in all, should be remembered, as indicative of a detrital commotion particularly unfavourable to the existence of invertebrated animals, and just such as might be expected to exist at the union of a rapid river with a heavy sea-swell.

## Pliocene Formation.

*Semi-consolidated or loose calcareous or siliceous Sands, Grits, or Conglomerates, with more or less Marine or Freshwater Shells, according to the nature of the deposit.*

In describing the "tertiary strata" of Cutch, Colonel Grant observes:—"A calcareous grit, which soils the fingers like chalk, also

occurs in patches, and contains innumerable small shells. It is used for building, and is burnt for lime; the beds are horizontal, and the surface of the country is generally covered with a fine rich soil." It is not distinctly stated whether this "calcareous grit" overlies the miocene formation just described; but, on the Western Coast of Kattyawar there exists a similar deposit, particularly in the neighbourhood of Porebunder, that does rest on the miocene formation. This is a kind of free-stone, in parallel, horizontal strata, which, yielding easily in the lines of the latter, afford slabs, that have for a long time been imported in great quantities at Bombay for architectural purposes, under the name of "Porebunder stone." The whole deposit would appear to be but a few feet (6?) in thickness, but, from its uniform structure and compactness, it serves excellently for flooring and for facing buildings. In 1848 I examined portions of it, both microscopically and chemically, and found it to be composed of minute foraminiferous shells, and a few grains of quartz and hornblende; the former semi-consolidating the whole mass, by a partial solution and recrystallization of their surfaces, and, when dissolved in acid, yielding yellow ochre casts of the foraminiferous animals they formerly contained. It thus became evident, that the so-called Porebunder stone was the marine type of a formation, which, from the presence of gritty particles of foreign matter, might vary in impurities of this kind to such a degree that in some parts it might be a coarse conglomerate, while in others it might be wholly calcareous. Portions of this formation from the creeks of the Runn, 9 miles north of Bhooj, were submitted to me for examination by the Government, to whom they were forwarded on account of their auriferous appearance. The speckled golden colour seems to be caused by the interlamination of yellow ochre with the nacreous layers of the foraminiferous shells. I state "appears," because I am not certain that this is the explanation, though I am certain that it contains no gold. The foreign particles in it consist of fragments of the trappean rocks, among which may be seen those of green-earth, their usual accompaniment.

From Cutch and Kattyawar let us turn our attention to the South-east Coast of Arabia, where there is a much better illustration of this formation. Here we find it plainly developed throughout, but it is only where the miocene formation presents the continuity of cliff mentioned that its position is clearly defined. There, it is seen to form the upper third of the cliff, and to consist distinctly of an elevated beach about 6 feet thick, composed of more or less conglomerate from the older rocks of the neighbourhood, which,

when traced into expanded plains between the base of the mountains and the sea, which have also undergone elevation, or over lowland parts unbacked by any mountains, becomes of greater thickness, and of greater purity. Opposite the northern extremity of the island of Masira, where the latter is the case, it presents an escarpment of about 100 feet, and, in composition, is a fac-simile of the Porebunder stone of Kattyawar. I have called it in my memoir on the geology of the Arabian coast "Miliolitic Deposit," from the facts mentioned. It is very oolitic in structure, but any name of this kind might confound it with "Oolite," while any one connecting it with an abundance of foraminiferous remains tends more to associate it with the tertiary formations to which it belongs.

On the western side of the Indus, where this formation is developed to a great extent from the vast quantity of *debris* brought down by that river, it chiefly consists of sands and conglomerates, formed in a great measure from the *debris* of the nummulitic or eocene deposits, and the shells of its own period, in greater or less abundance. It should be particularly remembered, in tracing out the limits of this formation in Scinde, that it may abound in fossils from the detritus of the Nummulitic Series, which, if not examined carefully, may be mistaken for deposits of this period.

The following section from above downwards of this formation at Minora Point, which is the western extremity of the entrance to the harbour of Kurrachee, has been given by Captain Vicary:—

| | |
|---|---|
| "Conglomerate | 60 feet. |
| "Sandstone | 3 ,, |
| "Oyster-bed | 2 to 4 ,, |
| "Sandstone, becoming highly calcareous, and containing innumerable *Turritellæ* | 5 ,, |
| "Fine-grained sandstone, no fossils apparent | —— |

Beneath this (I am informed by Mr. H. B. E. Frere, Commissioner in Scinde,) comes the lower blue clay; he also mentions that the hills at Jerruck, on the Indus, which are of this formation, rest on blue clay, as evidenced by a well sunk there, and that the former so covers the nummulitic rocks in Lower Scinde, that it is not until arriving north of Jerruck, which is upwards of 70 miles up the river, that they become exposed.

The Lesser Haroo range in Luss appears to be of the same formation, (Sub-Appenine of d'Orbigny?) and the greater one too, perhaps, among the mud volcanoes of the same province. In a rough sketch of a scarp of this formation in Luss, made by the late Mr. John Macleod,

and forwarded to the Society with specimens of its composition by Mr. Frere, its thickness is estimated at 1,000 feet. The specimens, besides being identical with the sandstone and light-coloured arenaceous clay which superposes the lower blue clay at Kurrachee, are almost identical with those which Lieutenant Constable presented to the Society as illustrative of the same formation on the islands of the Persian Gulf.

The only place where Captain Vicary appears to allude to the lower blue clay underlying this formation is in his description of the cliff at the Rund pass, on the Maulmaree river, which is "about 450 to 500 feet" above the latter, where he states that "an arenaceo-calcareous rock, agreeing closely with that of Kurrachee, rests at the base of the cliff on a variegated (red, white, and blue) laminated clay, apparently devoid of fossils."

In the following section, from above downwards, of the "relative position of the formations existing in Scinde," which is the upper part of that given at p. 250, there is also no mention made of this clay, though the upper blue or "black clay," which he considers a "post pliocene formation," seems to be included under "clays and sandstone":—

"Conglomerate.
"Clays and sandstone.
"Upper bone-bed.
"Sandstone (fossils rare).
"Lower bone-bed.
"Coarse arenaceo-calcareous rock, with *Cytherea exoleta*? and *exarata*; Spatangi; no Nummulites."

But in his section of the cliff on the Gauj river, (p. 304,) which is about 400 feet in height, and as far north as Larkhana, he observes that the bone-beds are underlaid by the "Kurrachee non-nummulitic rock," which is the last member of the section just given; in this case the ossiferous conglomerates may have to be grouped with this formation, instead of the lower blue clay, as they now stand.

Overlying the upper ossiferous conglomerate in the Gauj river is a bed of sandstone 150 feet thick, which, being the uppermost or last deposit, is probably continued on to the base of the Murree hills, where the confluence of the Indus with the branch formed from its four great tributaries takes place.

Passing across from this to the Doab of the Ganges, between Agra and Allahabad, we find the bone-bed, according to Captain E. Smith, from 100 to 150 feet below the level of the plain through which the Jumna now runs. In Dr. Spilsbury's section of the Omer Nuddi,

(p. 304,) the fossil bones were found 60 feet below the surface; and in the following section from above downwards, of the banks of the Godavery at Rakishbone, kindly sent me by Dr. Bradley, and to which I have before alluded,—between 40 and 50 feet of fluviatile deposits above the situation of the bones:—

"Soil.
"Fluviatile deposits, full of nodules of kunkur (travertin), 40 feet.
"Silt laminated, 3 feet.
"Large and small pebbles of trap, calcedony, onyx, agate, heliotrope, laterite, obsidian (2½ inches in diameter). All glazed with a rich brown vitreous coating, and their interior presenting the appearance of having been subjected to intense heat. The whole mass looking as if it had once been in a state of viscidity, 1 foot.
"Another bed like the former, compact in the upper part, and marly below where the bones of the extinct species of elephant were found.
"Below this trachyte, followed by red amygdaloid."

How much of these fluviatile deposits have taken place subsequently to the deposit of the bone-bed, and are to be given to the pliocene formations, future observation must determine. Captain Dangerfield states, that the banks of the Nerbudda between Mundlesir and Chiculdah present a fluviatile deposit of 70 feet in thickness, the upper part of which, viz. 30 to 40 feet, is light-coloured, and the lower one, from 10 to 15 feet, is of a redder hue,—the latter rests on basalt. At Hoshungābad, two wells of 70 feet each were dug in the Nerbudda conglomerate, without passing through it (Finnis); and at Gogah, in Kattyawar, immediately opposite the mouth of this river, where the late Captain Fulljames conducted his experimental bore, the following section, which I have condensed from his detailed one, was obtained:—

| | | | |
|---|---|---|---|
| Rubble | 4 | 0 | feet. |
| Sandstone | 45 | 0 | „ |
| Sandy clay, and sand and clay bands | 66 | 0 | „ |
| Blue clay (septaria and lignite) | 229 | 2 | „ |
| Blue clay | | | |

We have now to turn our attention to the southern part of the peninsula, and in connection with what has been stated, we cannot help seeing the similarity in relative position that exists between the lateritic deposit, with its red and white clay and variegated sands, and the lower blue clay of the coast of Travancore, and that which obtains between the pliocene deposits and lower blue clay, or its equivalents on the northern and western shores of India and its adjoining countries. Nor can we, when we look at the following table, fail to see the great

resemblance which exists between these deposits on both sides of the peninsula:—

| *Coast of Travancore.* | *Bore at Madras*, 1832. | *Madras.* | *Pondicherry.* |
|---|---|---|---|
| Feet. | Feet. | Feet. | Feet. |
| Loose brown sandy clay soil..... 6 | Sand & clay alternating..... 13 | Soil. | Surface gravel..... 2 |
| Lateritic deposits, (iron & graphite) 14–80 | Black clay..... 20 | Red Hills.—Lateritic conglomerate, composed of rounded pebbles of sandstone, &c. in clay ..... 6 | Loose grit, red..... 4 |
| Variegated clay, and sands. | Blue sandy clay... 12½ | | Grit, with weathered fragments of quartz, and felspar..... 3 |
| Blue clay. | Granitic gravel.... 10 | Yellowish tenacious clay with no pebbles. | Red grit, with rounded pebbles of greenstone and quartz, passing in its lower portion into a variegated & yellow grit. 5 |
| (Maj. Genl. Cullen.) | Granite. | (Cole.) | Variegated red and yellow grit..... 4 |
| | (Newbold.) | Blue clay? | All the beds below the gravel are interstratified with thin layers of greenish and white lithomargic clays. |
| | | | (Newbold). |

I have thought it proper to place the blue clay below the lateritic conglomerate of the Red Hills, both at Madras and Pondicherry, because in the section of the bore made at the former, which is given in the table, it will be seen that black and blue clay rest on a thin bed of gravel belonging to the granite immediately below; in fact may be considered the lowest deposit, just as it probably is the lowest deposit on the Malabar Coast, where it also underlies the lateritic deposits. Newbold's section of the Red Hills at Pondicherry being only 23 feet, and not reaching down to the blue clay, and Mr. Cole, not having been able to obtain a section of the lateritic conglomerate of the Red Hills beyond 15 feet, affords us no assistance in this way.

This is all that I have to offer on the pliocene formations, which I shall not attempt to divide here, as in the present state of our information it is impossible. But I cannot help thinking that there are two ossiferous conglomerates, one of which, perhaps, belongs to the miocene, and the other to the pliocene deposits.

The fact, too, of *Charoideæ* existing with Nummulites in the upper member of Captain Vicary's nummulitic deposits, (p. 250,) and the presence of the capsules of *Chara* in the lower blue clay at Kurrachee, to which I ought to have before alluded, should not be forgotten.

*Evidence of Volcanic Disturbance and Effusion between the deposit of the Eocene and the end of the Miocene and Pliocene Formations.*

Commencing with Grant's "Geology of Cutch," which gains our confidence the more we examine that of the adjoining countries, it is perfectly evident, that since the deposit of the oolitic beds of that province, they have undergone the elevation which has raised them to their present level; and that during their ascent through the sea, they may or may not have been denuded of the subsequent formations which took place between the oolitic and the commencement of the miocene periods; the previous existence of these formations upon them depending on the oolitic beds having been above or below the water when they were deposited.

If the whole of the oolitic beds had been below the water during this time, and had undergone gradual, or, as it is termed, "passive" elevation, then it seems reasonable to infer that they would now have had more of these formations upon them; whereas they have only the small patch of nummulitic limestone, in the north-western part of Cutch, mentioned. If, again, the whole, viz. the nummulitic, cretaceous, and oolitic beds, had undergone paroxysmal elevation together, then also the latter, in their highest parts, might have been expected to have retained at least some small portions of the nummulitic and cretaceous beds. It seems, then, reasonable to conclude, that the nummulitic and cretaceous never did rest upon the oolitic beds of Cutch, to any great extent, any more than they have rested on the oolitic beds in any part of India; and, therefore, that those of Cutch, for the most part, having been above water when the nummulitic limestone was deposited, must have descended to have received the miocene and pliocene formations which now rest upon them.

A question, then, arises, whether the nummulitic beds in the north-western part of Cutch, and in Scinde, which rest on the oolitic beds, did not also descend with the latter at this time to receive the miocene and pliocene deposits which rest upon part of them? And to this it must be answered, that the fact of the flat-topped, isolated tracts of the Nummulitic Series, which project above the alluvial plain of the Indus, presenting no miocene or pliocene deposits on them, so far as my observation and knowledge extend, and Colonel Grant's statement that the tertiary formation "abuts" against the nummulitic limestone also in Cutch, proves one of two things—either that the part of the Nummulitic Series on which the miocene and pliocene formations now rest never rose above the water until the latter were deposited, or that it

went down partially or wholly, after the convulsion had occurred which threw up the Hala range, and isolated tracts of the alluvial plain; the intervening portions of the Nummulitic Series having at that time been more or less broken up, and taken into the formation of the miocene and pliocene deposits.

It seems plain, then, that the Nummulitic Series underwent great displacement and destruction before the deposit of the miocene and pliocene formations; and it is also plain, from the height to which the latter have been raised, that a great paroxysmal change also took place after they had been deposited; but it is not so plain that the Nummulitic Series underwent any depression previous to, or during the formation of the miocene and pliocene deposits; though the descent of the oolitic beds of Cutch, close by, to receive it, would suggest this inference.

These facts, and this reasoning, then, tend to the conclusion that the Nummulitic Series of Scinde and of Cutch has undergone two successive elevations, if not a depression also, since its formation and the end of the miocene and pliocene periods.

To what degree the elevation of these formations has extended may be conceived, when the former would appear to cap the table-land of the central part of the South-east Coast of Arabia, which is 4,000 feet above the level of the sea, (Geol. SE. Coast of Arabia, this Jl. vol. iv. p. 21,) and the miocene and pliocene is seen capping Gibbel Ghara, at Makalla, which is 1,300 feet above it. Scinde and Beloochistan would furnish similar facts if they were needed; but the extremes given are only instances of the displacement of the eocene, miocene, and pliocene formations, which in a more modified degree has taken place throughout the countries mentioned.

With such disturbances, we must of course expect here and there to have volcanic effusions; but to separate these effusions into those which took place through the nummulitic limestone previous to the deposit of the miocene and pliocene formations, from those which followed the latter, necessitates, where the miocene and pliocene formations are not present, a knowledge of the differences in the mineralogical characters of the rocks effused, if there be any, which at present we do not possess; while the large tracts of basalt which we shall find overlying the miocene and pliocene deposits, as well as breaking through them in many parts, claim our attention, from the assistance they may afford in recognising effusions of the same age in India—more than those which may or may not be confined to the Nummulitic Series.

As usual, we must return to Cutch, where Colonel Grant, under the head of "*Distinct Periods of Volcanic Eruption,*" states, with reference to the tertiary deposits:—

"At the village of Doonee above mentioned, [in the southern part of Cutch,] the banks of the river present a perfectly perpendicular wall, from 15 to 20 feet high, and are composed of calcareous grit or coarse limestone, alternating with basalt, in the following order: first grit; then a horizontal bed of round pieces of basalt; and next, another stratum of the grit 15 feet in thickness; the whole being covered by the basalt forming the hills." Near the village, again, of Kerooee, is a second instance, where the banks of the river are "composed in some places of the basalt forming the Doura range; and in others entirely of the limestone grit, which in some places overlies the basalt, but forced up into anticlinal lines, as if the igneous rock had been protruded from below; the broken state of the strata showing that it was not originally deposited in this position. The bed of the river at this place is entirely composed of basaltic columns; their horizontal sections forming a regular pavement; and large masses of the columns, occupying from 200 to 300 square yards, and being about 8 feet in height, remain, every here and there, similar to a field of corn partially reaped. The columns are very regular, generally four sided, with smooth even surfaces, and are composed of a hard, compact, dark-blue basalt."

In a third instance, he adds, at the end—"Further on, * * where the dykes of basalt occur [in the calcareous grit], the limestone lies in immense masses, evidently broken off at the time of the projection of the upper bed of igneous rock; being itself of subsequent formation to the lower basaltic bed of rolled masses. This is very distinctly shown at one part of the pass, and it should be mentioned that the bed of the ravine consists throughout of irregular broken basalt."

It will be remembered that Colonel Grant's "calcareous grit" forms a part of his tertiary, and of our pliocene formations.

To the superposition of basalt on travertin, which is also underlaid by basalt, in Cutch, I have already alluded (p. 281), the superficial bed of basalt being 20 feet thick, columnar, "very hard, compact, of a dark-blue colour, and smooth surface."

But it is on the South-east Coast of Arabia that the basaltic effusions of this age are best seen, where they overlie the miocene deposits on the flat belt extending from the base of the mountains to the sea. There are three of these tracts almost touching each other, midway between Ras Sharwain and Ras Makalla, with one or more cones in each, and they all form a striking contrast in colour with the white

limestone of the mountains behind, and the white deposits over which they are spread. Their general flatness, rising almost imperceptibly from their well-defined borders to the cone or cones about their centres respectively, which do not appear to be above 200 feet in height, is also very remarkable. At their circumference they are reduced to large detached blocks and loose stones, but further in, the mass is continuous and columnar. Altogether, they extend over an area of about 45 miles long by 10 broad, the latter being the breadth of the plain between the base of the mountains and the sea at this part of the coast, so that they occupy about 450 square miles, and I dare to say, if we could trace them under the sea, into which they have flowed, more than double this amount. Towards their south-western extremity, where the miocene formations have been raised about 100 feet above the sea, the basalt not only covers the surface, but, having been effused subsequent to its elevation, appears in the beds of the watercourses which open upon the beach.

I have alluded to these striking effusions on the South-east Coast of Arabia for comparison, because its geology is so linked with that of Cutch, and because this coast is so near the western part of India.

Having thus established the existence of great basaltic outbursts over the miocene and pliocene formations of Cutch and Arabia, let us now see if there be any evidence of volcanic disturbance or basaltic effusions in connection with the great trappean district of India, which have also taken place since these periods.

That there have been great disturbances since the ossiferous conglomerate was deposited on the eastern side of Kattyawar may be reasonably inferred from the detachment of Perim island, which is not only capped with this conglomerate, but is separated from the coast of Kattyawar by a channel or chasm 240 feet deep, while on the other side it has, in one part, 1,060 feet of water. Dr. Malcolmson, too, who visited the so-called cornelian mines, on the mainland of India opposite, states, in alluding to the presence of "trap pebbles" in them, that they have been altered by the intrusion of more recent igneous rocks, which he proposed to describe in detail at a future period; but he did not live to carry his intention into effect, having died of fever on a subsequent geological excursion in this direction.

For direct proof, however, of basaltic effusion since the deposit of the ossiferous conglomerate, it seems that we must go to the upper part of the Nerbudda, near Jubbulpore, where, according to Dr. Spilsbury, we shall find the calcareous conglomerate in one part covered by a bed of compact basalt, "conformably stratified," and "presenting

a clear section" in "three hills." The hills are about 150 feet in height, and the capping of basalt, according to the section, (which is given on scale,) about 40 feet in thickness.

Over this, unfortunately, Prinsep has thrown the following conjectural doubt, which I do not think the expressions in inverted comas above mentioned justify, viz.—in alluding to the basalt stated by Dr. Spilsbury to overlie the calcareous conglomerate containing the fossil bones, Prinsep states, "unless that the breccia containing them [the bones] occurs only in exterior patches, formed of their detritus, and containing also portions of the basalt, which one or two of the specimens, whose labels are lost, seems to render probable," that is, in other words, "unless the ossiferous conglomerate *abuts* against the basalt." In opposition to which, it might be observed, that the portions to which Prinsep alludes may have been a subsequent formation of the *debris* of both basalt and conglomerate; but of course it is impossible to say who is right, Dr. Spilsbury or Mr. Prinsep; though, in making use of the facts contained in Dr. Spilsbury's communication, it seems much safer to lean to the view of one who appears to have seen the basalt overlying the conglomerate repeated in "three hills," and to have examined them on the spot with no inconsiderable attention, than to one who, at a distance, doubts the correctness of the author's observations from the examination of a hand-specimen.

Bearing upon this question is the following extract from an unpublished account of the "Fossil Sites" about Saugor, in Central India, by Captain Nicolls, of the Madras Army.

Under the head of "Narrainpore," a village situated among sandstone hills and small tracts of trappean rocks, about 17 miles south-east of Saugor, and about 9 miles due west of Railey, another village which is just beyond the eastern border of the trappean district of Malwa, and at the south-western extremity of the extensive tract of limestone which partly overlies the sandstone of Bundelkhund, Captain Nicolls states:—"I found fossils in three spots on the surface of the regur soil. At the first spot, fragments of dicotyledonous wood, with one fragment of palm, one fragment of fossil bone, and a fossil palm (?) seed converted into tuffaceous lime. At the second spot fragments of large bones strewed on the surface of the black regur soil, and one or two fragments of fossil wood, together with irregular flat pieces of tuffaceous limestone loose upon the surface. These bones are silicified: one small specimen is contained in the limestone sent to you (which is dendritic in the specimen). In the concave end of a vertebra found here, the tuffaceous limestone is present independently of any exterior

connection, and having something the appearance of nodular kunkur. I can observe no medullary canal in these fragments, the largest of which is like the head of an elephant's humerus, 14 inches broad, by 11 long. The third spot is about 150 yards from the last, and here I found dicotyledonous wood only. All the wood of the above three places was in fragments not more than 7 or 8 inches long. They lie on the black regur soil, and I see nowhere else that they could have come from but out of it. As will be observed by the map, there is sandstone in the neighbourhood of these fossils, about three quarters of a mile off. At the third spot, the under strata are remarkable, viz. about 2 feet of black soil, then 2 feet or 18 inches of concentric lamellar trap, with a hard central nodule. This trap continues for some distance of the same thinness; below it is a chalky friable white earth, the bottom of which was not seen." Again, he states of the latter:—"Half a mile from Soorkee the white chalk-like earth is seen to the depth of about 15 feet immediately below the regur soil."

These interesting facts, then, indicate—1*st*, that fossil wood and bones silicified are found together; 2*nd*, that they are in or upon a thin stratum of regur (black soil), which overlies a thin stratum of nodular or decomposing trappean rock; 3*rd*, that this trappean rock is underlaid by a white chalky earth; 4*th*, that a tuffaceous limestone, which is dendritic, surrounds and fills some of the silicified fossils; and 5*th*, that all this exists in the midst of sandstone and trappean hills, which, as before stated, are within 9 miles of the south-western extremity of the limestone tract overlying the sandstone of Bundelkhund, the trappean hills being, in fact, the fringed out border of the trappean district of Malwa, which also rests on the sandstone of this side.

Now it seems extremely probable from this, that the white chalky earth does contain fossil wood and bones, and that this deposit is overlaid in some parts by basalt, as in Dr. Spilsbury's section. It seems also likely here, that the regur is the decomposed basalt (a subject to which we shall have to recur hereafter), and that the fossils which are on its surface have come from the white chalky earth below. Lastly, that the overlying limestone tract of Bundelkhund, which Franklin considered equivalent to the lias, and which I have placed among the Kattra Shales of the Oolitic Series, seems now so likely to be a part of this white chalky earth, that I doubt very much whether I have not given it a wrong position. There is no part of India which is so interesting in a geological point of view as the district of Saugor and the adjoining part of Bundelkhund, because it appears to offer a clear explanation of so many points of this kind now in doubt.

I would also add, that independently of these fossil bones and wood bestrewing the regur, like the fossils of the intertrappean lacustrine formation in many parts of India, the siliceous infiltration of the great cancellated bones which Captain Nicolls has kindly presented to the Society has the same bluish, transparent, opaline or calcedonic appearance as that of the silicified masses of small shells of this formation which are found in many parts of India, and also in the neighbourhood of Saugor itself.

To the above evidence of trappean effusions having occurred since our pliocene formations were deposited, I have only to add a short description of the crater of Loonar, which is situated near the village of that name, about 70 miles east of Aurungabad.

Throughout the whole of the great trappean district of Western India this is the only spot which has hitherto afforded any traces of a volcanic vent, and, therefore, we may infer, that it was probably here that the last outburst, to any great extent, took place. Of this extinct crater, Dr. Bradley has kindly furnished me with the following account:—"There cannot be a doubt of the origin of the lake of Loonar. I found, in 1852, scoriaceous rocks that fully told its history. Its upper edge, [which, according to Malcolmson, who has given a short account of it, is "circular or oval,"] is about 5 miles in circumference, and the Natron lake, which occupies its centre, about 3. Its sides are about 500 feet above this lake, to which they slope at an angle of about 18°, and are breached by fissured chasms, in various directions, but chiefly through the northern and eastern scarps. Dykes of greenstone are plainly seen just under the temple with the cow's mouth. The lavic currents seem, principally, to have found vent at the north-east, and to have escaped through a deep narrow gorge, the sides of which are burnt and semifused by the passage of the molten rock. The stream rolled onward beyond the city now occupied by the town of Loonar, and is seen forming step-like masses, on to the bed of a deep ravine, a little to the eastward of this place.

"Viewed from a point in a line with the axis of the plateau on which the crater is formed, little elevation is apparent, but looking at it across, you become aware of a tumular-shaped rise in the undulating ground around it, which on the south presents a mound about 60 feet high, the sides of which slope at an angle of about 50°. This slight elevation does not arise from volcanic accumulation, but simply from the tumefaction occasioned by the gaseous expansion that has hurled its central parts into the air; evidence of which may be seen in the ravines, where a true section of the walls of the crater exposes the

beds of which they are composed, inclining from the crater outwards. Beneath the basis of the mound, on its outer and south-eastern side, is a hillock, upon which rests a thin layer of scoria, apparently the thinning out of a lavic current."

These are the latest traces of volcanic disturbance and outburst in India which have been recorded. That the disunion of Perim island from the coast of Kattyawar, and the effusion of basalt which overlies the ossiferous conglomerate near Jubbulpore, took place at least after the formation of some of the tertiary deposits, there can be no doubt, and the active state of the crater of Loonar appears to be equally modern; but unless the dark-blue, compact, columnar basalt, overlying the tertiary formations of Cutch, and that of the great trappean district of Western India, can be identified by their sameness of mineralogical characters,—and that sameness is peculiar to a basalt of India which overlies a tertiary deposit of the same geological age as that of Cutch,—there can be no means, that I see, of distinguishing, or of separating, generally, the basalt of this age in India from the other trappean effusions.

Fortunately we have the intertrappean lacustrine formation to assist us in this respect; and if it shall be hereafter proved that this is of the older pliocene period, as the presence of the remains of frogs in that of Bombay would seem to indicate; that this formation exists towards the summit of the isolated mountains of the Western Ghauts; and that it is never capped but by a basalt possessing peculiarities which distinguish it from all other trappean effusions that have preceded its advent,—then we shall not only be able to identify the latter as a post-pliocene basalt, but have a strong chain of evidence to show that the great trappean district of Western India was not broken up until the last volcanic effusions had been ejected, and that the Ghauts were not elevated until the post-pliocene age.

That the intertrappean lacustrine formation took place after the trappean effusions had began to be poured forth is indicated by the presence, as before stated, of *scoriæ* in some parts of its strata in the island of Bombay.

As an instance of an extinct volcano in Cutch, Colonel Grant gives a description of a crater near the shores of the Runn, which is called Denodur; it is the highest hill in the country. In its north side is a large gap, and a wall of basalt apparently continues all round the top. He also adds, that all the other volcanic hills in that part appear to be similarly constructed.

Near the village of Wagé-ke-Pudda, also, is "a space of about two

square miles, blown out into a flat basin, the sides being broken into fissures, with craters, ravines, and hollows, and the interior or bed of the basin interspersed with hillocks, and cones of every variety of colour,—black, red, yellow, and white,—and with patches of cinders similar to the refuse of a furnace; the whole looking as fresh as if the igneous agents were still in operation. Within the circle, also, are several small craters, or circular spaces, surrounded by walls of basalt. One more perfect than the rest is about 40 feet high, and composed of compact columnar basalt, with a talus of sand and scoriæ."

The same author also observes of this space:—"The cones and banks of loose scoriæ must be yearly washing away, and it is difficult to conceive that the walls of solid basalt forming the sides of the craters can belong to a similar period, having all the appearance and texture of very old basalt; but it is possible that a recent eruption may have taken place in the site of one of more ancient date, thus presenting a mixture of old and recent volcanic products. If it is true that basalt owes its columnar structure to its cooling slowly under a great pressure, it is impossible that these masses of columnar basalt and the loose cones of scoriæ can be contemporaneous."

Lastly, partial alterations in the level of the country in Cutch have taken place even as lately as 1819, when they were produced by an earthquake; and passive elevation still appears to be going on insensibly throughout India.

## XII.

### Post-Pliocene Period.

| | |
|---|---|
| Marine..... | *Sands and Conglomerates, with more or less Marine Shells, loosely united.* |
| | *Upper Blue Clay, with Marine and Freshwater Remains.* |
| Freshwater. | *Regur.* |

### Marine.

The example of these formations with which I am most familiar is in the island of Bombay, where I have had an opportunity of studying them.

Here, their maximum thickness is about 20 feet, two-thirds of which is below the level of the sea at spring-tides; and from the horizontality of their surface, they appear rather to have been deposited in the sea, and afterwards raised bodily, than to have been formed by beach-accumulation, from which the sea had gradually retired.

As with the tertiary formations just described, so with these, we have a deposit of blue clay, covered with sands and sandy conglomerates.

*Blue Clay.*—This is a stiff, plastic deposit, of a fine uniform texture; of a brown colour above, and blue below, also yellowish where it mingles with the decomposing rocks on which it may chance to rest. When pure, it does not effervesce with acids. Its maximum thickness is about 10 feet, but this of course varies with the irregularities of the surface on which it has been deposited. Towards the sea it thins out, and is there concealed by the beach, which is now in process of formation, while, further in, it is covered by the sands and shelly conglomerates of its own period. It exists throughout the island resting on the trappean rocks, or the intertrappean lacustrine formation, where the latter has been denuded.

Like most argillaceous deposits, it contains, comparatively, very few organic remains, these being chiefly confined to the overlying conglomerates, as in the tertiary formations. Here and there, however, fragments of wood occur, in greater or less number, which appear to be the stumps of mangrove trees. These are in a soft, spongy state, when first exposed, but, on drying, shrink greatly, and assume the form of hard lignite, breaking with a smooth conchoidal fracture, and presenting a shining, dark brown colour. In this state, if lighted, it burns for a short time, with a feeble flame, gives out a woody odour, and then smoulders into a white ash. This wood has for the most part been perforated by some large xylophagous *Teredo*, which has left a number of undulous tubes in it, averaging about three-quarters of an inch in diameter, and these have subsequently become thickened by the addition of more carbonate of lime to their surface, and filled with blue clay or kunkur.

A few bivalve shells, together with remnants of crab-claws and pholadine tubes, are also found in the clay, but there appears to be a strong tendency in the calcareous material to pass off by solution, and leave nothing but their impressions. Beds of oyster-shells also exist on detached blocks and large stones, on the trappean formation beneath the clay.

Nodules of concretionary carbonate of lime, called kunkur, abound in it, similar to those of the interior of India. They are more or less impure, on account of admixture of the blue clay in which they are formed, and from which they appear to derive their bluish colour. Some few portions are white and chalky, when they are entirely composed of carbonate of lime. They are more or less hard, of a compact or earthy structure, and break with a uniform dull fracture. A

fragment of wood, grass, or a shell, frequently forms the nucleus of the nodule, around which the carbonate of lime accumulates by segregation, tending always to a globular form, after which the nucleus becomes absorbed, and its mould alone remains. The globular form of the nodule does not always depend on the presence of a central nucleus, as it is occasionally seen attached in this shape to the side of the organic body.

In some localities this concretionary calcareous formation is irregularly continuous, when it is called "sheet kunkur," and in Bombay lies at the bottom of the clay, imbedding more or less gravel.

There is also another formation, of the kind called "old kunkur," and this has a concretionary botryoidal form, not unlike globular magnesian limestone; when compact, therefore, it presents on fracture a spheroidal structure, but with the interstices filled up, and each spheroid presenting a central nucleus. This kind would appear to belong to the tertiary deposits.

The kunkur formations, in Europe called travertin, are prevalent throughout India, but do not exist in the recent deposits, except in transported fragments; neither does kunkur exist on the Neilgherries (Benza).

The blue clay immediately under the surface soil at Calcutta appears to be of the same age as that of the island of Bombay. Like the latter, also, it contains logs and branches of a red wood. After a covering of 20 feet of mould, sandy clays and sand, the blue clay extends down to about the 60th foot below the surface, (see section of a "bore" which was made in Fort William in 1829,) when it passes into a yellow clay with kunkur; this, after the 125th foot, is followed by "grey sand" for about 45 feet, which rests on granitic gravel at 170—176 feet. The extreme thickness of these deposits, compared with the blue clay of the island of Bombay, may be explained by the former having been brought down by a great river from a vast extent of country, and the latter by the rivulets of the neighbouring mountains, which only flow during the monsoon.

The other details of this experimental bore, which appears to have been carried on till 1837, I have not seen, but Newbold states, that at 250 feet came a bed of quartzose and micaceous sand, from which, "at 350 feet, the augur brought up the lower half of the humerus of some animal of the canine species." Then came "black peat clay, imbedding black carbonised wood, between peat and lignite, and perfectly carbonised wood, resembling the coal of Assam, in rolled lumps"; the latter from a depth of 392 feet. "Lastly, two fragments

of a fossil *Testudo*, and a rolled fragment of vesicular basalt, were brought up from the depth of 450 feet."

The deposits below the quartzose and micaceous sand may, perhaps, be referred to the miocene period.

*Sands, Shell-Concrete and Conglomerates.*—This formation, which overlies the blue clay, occupies several square miles of the plains in the island of Bombay, and presents a horizontal surface, raised, as before stated, about 20 feet above high-water mark, at spring-tides. It is chiefly composed of yellow sand, and beds of small shells, which in some parts pass into a coarse conglomerate of gravel and rounded pebbles, formed from the *debris* of the trappean rocks of the locality.

The sands chiefly occupy the upper part, and, becoming more shelly downwards, pass into beds of shells and shell-concrete; which, again, changes to coarse conglomerate at the bottom.

The shell-concrete is sufficiently consolidated to form a rough building material, and has been a good deal quarried for this purpose; but it is only used in the construction of the meanest buildings, on account of its cheapness on the one hand, and its indurability on the other.

The shelly beds are chiefly composed of small bivalves which have lost their colours, *Cardium* and *Tellina*, with which are mixed a few univalves, *Turbo*, *Cerithium*, and *Nerita*, and here and there a large *Trochus* and *Turritella*, and a thin pearly *Placuna*;—in short species of all the genera now to be found on the shores of the island of Bombay. Yet, if a handful of the former be taken up indiscriminately, and compared with one from the latter, a perceptible difference between them, independently of want of colour, will be seen, in the peculiar prevalence of one species over another.

These beds rest on the blue clay inland, and are covered by the present beach towards the sea. In no instance have I ever seen a trace of anything like artificial remains or human bones in them.

At Kurrachee there is a similar series, consisting of sands and conglomerates above, with blue clays below, resting on the sands and conglomerates of the miocene period; also in the back-waters on the Malabar Coast, near Quilon, and at Cape Comorin (Genl. Cullen).

## Freshwater.

*Regur, or Black Soil.*—This is in some parts from 20 to 40 feet in thickness, and is considered the best cotton ground. It consists of a fine, black, argillaceous mould, which contains in its lower part nodules, and even beds of kunkur and pebbly alluvium, and presents on

its surface scattered angular fragments of the neighbouring rocks, particularly fragments of chert and jasper from the intertrappean lacustrine formation, with calcedonies, fragments of quartz, geodes, agates, &c. from the trappean rocks. It exists in large tracts here and there, and seems to have been chiefly derived from the disintegration of the trappean rocks; but on this there is a difference of opinion.

Voysey and Christie give it this origin, to which Newbold is opposed. The latter objects to it on the grounds that the disintegration of the trappean rocks yields a "red" and not a "black" soil, and that the elevation of the surface of many of the tracts of regur above that of the beds of the present rivers, together with its extensive horizontality, indicate a deposit from general submergence rather than fluviatile transport. He also considered its black colour due to carbonaceous admixture, but owns that it is as difficult to point out "the origin of one as that of the other."

Here Newbold seems not to have recollected the black surface presented by the trappean rocks, which clearly proves that when their particles are thus thoroughly exposed to the action of the air, sun, and water, for a certain time, they do become black; while the disintegration of these rocks below the surface is generally red, but not always, for sometimes they pass into a grey or greenish brown wacken. Hence, then, the red disintegrated particles beneath the surface, when equally exposed to the air by transport, might also become black. With reference to the elevated position of the regur in some parts, and the great horizontality of its tracts in others, these might be accounted for by the changes of level which have taken place since their deposit, or since the miocene era, for the lower part of the regur must, I think, belong to this period; and its horizontality may have been effected previous to its upheaval, in the same way as that of the alluvial plain of the Indus or any other great river, the streams of which, constantly varying in their position from side to side, at last leave an almost even plain.

The origin of the regur, again, seems to be answered by the following questions:—What has become of the enormous amount of material that has been weathered and washed off the trappean effusions, among which there is now hardly a crater or a piece of scoria to be found? Where does any part of the trappean effusions overlay the regur? And from what older rocks than the trappean could the regur have been derived? Or if it could have been, or was derived from the older rocks, what, again, has become of the material arising from the disintegration of the trappean ones?

That the regur may have been partly blackened by the growth and decomposition for ages of vegetable matter in it no one, I think, will deny; but that the last detrital formation in India, which appears to have been immediately preceded by the trappean effusions, should be chiefly derived from any other rocks, and in any other way than that which I have mentioned, seems to me incompatible with the facts at our command. Were the trappean effusions confined to a small space, the matter would be different; but when we consider that one-fourth of Hindustan Proper is now covered by a continuous sheet of trappean rocks, and that dykes and small patches exist in the greater part of the other three-fourths, all of which are inconceivably reduced from their original dimensions, the existence of large tracts of black earth throughout India seems to be as natural a consequence as the formation of older strata from an eruption or destruction of rocks in their vicinity. —Thus the miocene formations in Scinde are so made up of the fossils and *debris* of the Nummulitic Series, which immediately preceded their formation, that it becomes a matter of difficulty sometimes to say which is which.

Lastly, the facts mentioned by Captain Nicolls, viz. that at the village of Narainpore, in Central India, 9 miles south of Saugor, 2 feet of black soil in one place rests on 2 feet or 18 inches of nodular basalt, which, therefore, must be decomposing, shows that the whole of this basalt will soon become a part of the black soil; while Dr. Adam, after having stated that this is the prevailing soil in the part of Bundelkhund over which he travelled, adds:—

"The black soil has evidently been derived from the decomposition of some of the many varieties of trap rock, most probably amygdaloid or green earth, which appear to have rested at one time over the granite in the hills of Bundelkhund. The trap rocks at Gerawah and Bisramgundj, and the globular variety of Kalinghur, may also have had a share in forming it. As I remarked before, many of the trap boulders are now in a soft state, bordering on earth, and can be reduced to powder with the greatest ease. The soil immediately around, there can be no doubt, is formed of their *debris*, and as the plain in general resembles that, we may reasonably infer that it also acknowledges a similar source."

## XIII.

### Recent Formations.

These I need not describe; they may be seen on our beaches, and in the alluvial deposits of the rivers which form the boundaries of the tract we have had under consideration.

*Theory.*

As a theory of the geological formation of a country is frequently desirable for the right understanding and remembrance of the facts contained in its geological description, so I feel called upon to terminate this "Summary" with a few observations on the manner and sequence in which the different formations of India appear to have been produced. At the same time I feel that it is perfectly useless to attempt this further back than the commencement of the Oolitic Series, for it will have been seen by the foregoing pages, that there is little or nothing to assist us in theorizing respecting the formation or position of the Plutonic Rocks and Metamorphic Strata previous to this period, and that even since, our knowledge of the subsequent formations is so scanty that it hardly justifies a conjecture.

Leaving the reader, then, to supply with his imagination the state and position of the Plutonic Rocks and Metamorphic Strata previous to the commencement of the Oolitic deposits, I would suggest for consideration—

1*st*.—That the Oolitic Series, which appears to contain the coal beds of India,* was deposited by rivers flowing from the north.

2*nd*.—That the marine beds of this series, (indicated by their shelly nature,) at the southern extremity of India, and in Cutch, seem to point to the outskirts of this delta, or the margin of pure salt-water, during this period.

3*rd*.—That this delta, viz. the greater part of India, was raised above the level of the sea before the Cretaceous and Nummulitic Periods commenced, while its eastern and western borders, extending to the Himalayas on one side, and in the direction of Scinde and Beloochistan on the other, still remained under water.

4*th*.—That the deposits of the Cretaceous and Nummulitic Periods, which now form part of the sub-ranges of the Himalaya mountains,

* It might be supposed by some, that because this coal is of the Oolitic Period, it can never beat the English coal of the Carboniferous Series out of the Indian market; but the following extract from a note which accompanied a present of a specimen of Burdwan coal to the Society, by J. Ritchie, Esq., Superintendent of the P. and O. Company's Steamers in Bombay, furnishes most satisfactory evidence to the contrary. Mr. Ritchie states:—"I consider that it will be a valuable coal for steam purposes.—At the Mint, and also at this Company's Workshops in Calcutta, it has been converted into coke nearly equal to that from England, and costing considerably less." When the proposed railway, then, is completed, which is to connect the Western Coast of India with Calcutta, the coal beds of India will become still more available, for this must pass through the districts in which they appear to abound most, and to be nearest the surface.

and the Hala range of Scinde, &c. were formed and raised above the level of the sea, leaving a gulf on each side, one in the present course of the Ganges, and the other in the course of the Indus rivers.

*5th.*—That the Miocene and Pliocene deposits were formed in these gulfs, and were also raised above the level of the sea, causing the latter to retreat almost to its present margin.

*6th.*—That the alluvia of the Ganges and Indus were deposited.

With reference to the advent of the trappean effusions, it would seem—if the coal formation resting on "secondary trap" in the Rajmahal hills should hereafter prove to be a part of the Oolitic deposits, as Dr. M'Clelland supposes, and also to have been deposit on this trap,—that the Trappean Period extended from the deposit of the Oolitic Series down to the breaking up of the Miocene and Pliocene deposits, inclusively.

The Diamond Conglomerate would, then, have been formed after the commencement of the trappean effusions, as it rests upon the Oolitic Series.

The deposits of the Intertrappean Lacustrine Formation seem to indicate a long interval of volcanic cessation previous to the outpouring of the basalt, which overlies them in the Great Trappean District.

## *Authorities.*

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### *Papers.* *

*Abbreviations.*—Journal of the Royal Asiatic Society, Jl. R. A. S.—Asiatic Researches, As. Res.—Gleanings in Science, Gl. in Sc.—Journal of the Asiatic Society of Bengal, Jl. A. S. Bl.—Madras Journal of Literature and Science,

* It was my intention to have given a list of the titles of these papers *in extenso*, but it would take up more room than can be afforded. I must therefore be content with giving the names of the publications only in which they are to be found respectively.

## *Provisional Table of the Igneous and Sedimentary Rocks of India.*

| | | | | |
|---|---|---|---|---|
| | XIII. Recent. | ..... | Deposits now taking place. | |
| Post-Tertiary ..... | XII. Post-Pliocene..... | *Marine* ..... | Sands, Shells, and Conglomerates. Upper Blue Clay. Kunkur (Travertin). | |
| | | *Freshwater*... | Regur. Kunkur. | |
| | | ..... | | X. Trappean Effusions, 2nd Series. |
| Tertiary ..... | XI. Pliocene ..... | *Marine* ..... | Semi-consolidated or loose calcareous or siliceous Sands, Grits, Shells, and Conglomerates. | |
| | | *Freshwater*... | River Conglomerates. Old Kunkur. | |
| | Miocene ..... | *Marine* ..... | Solid, coarse, shelly Limestone. Oyster-beds. Calcareous, argillaceous, quartzose or sandy Conglomerates. Lower Blue Clay. Ossiferous Conglomerate. | |
| | | IX. *Freshwater* .. | Intertrappean Lacustrine Formation. | |
| | | ..... | | VIII. Trappean Effusions, 1st Series. |
| | VII. Eocene..... | ..... | Nummulitic Beds and White Marl. | |
| Secondary ..... | VI. Cretaceous..... | *Marine* ..... | White Limestone, Arabia and Scinde ? (1,400 feet ?)<br>Upper Greensand and Gault, (Albien, d'Orbigny,) Trichinopoly and Verdachellum.<br>Lower Greensand, (Neocomien, d'Orbigny,) Pondicherry. | |
| | | | Diamond Conglomerate ? | |
| | | | Punna Sandstone. ..... | ..... (Trappean Effusions ?) |
| | | | ..... | Eruption of Felspathic and Hornblendic Rocks. |
| | V. Oolitic ..... | *Freshwater* .. | Kattra Shales..... *Freshwater* ? . Shales. Limestone. Coal. | |
| | | | Kattra Shales..... *Marine*. ..... Cutch. Pondicherry. | III. |
| | | | Tara Sandstone. (Old Red ? M'Clelland.) | |
| Primary ..... ..... | IV. Cambrian and Silurian (M'Clelland). | ..... | Transition Gneiss, with micaceous and hornblende Schistose Beds.<br>Newer Clay Slate, with quartzose and steatitic Sandstone Beds. | |
| | | | ..... | Eruption of Felspathic Rocks. |
| | II. Metamorphic Strata. | ..... | Gneiss. Mica Schiste. Hornblende Schiste. Clay Slate. Granular Limestone. | |
| | | | | I. Primitive Plutonic Rocks. |

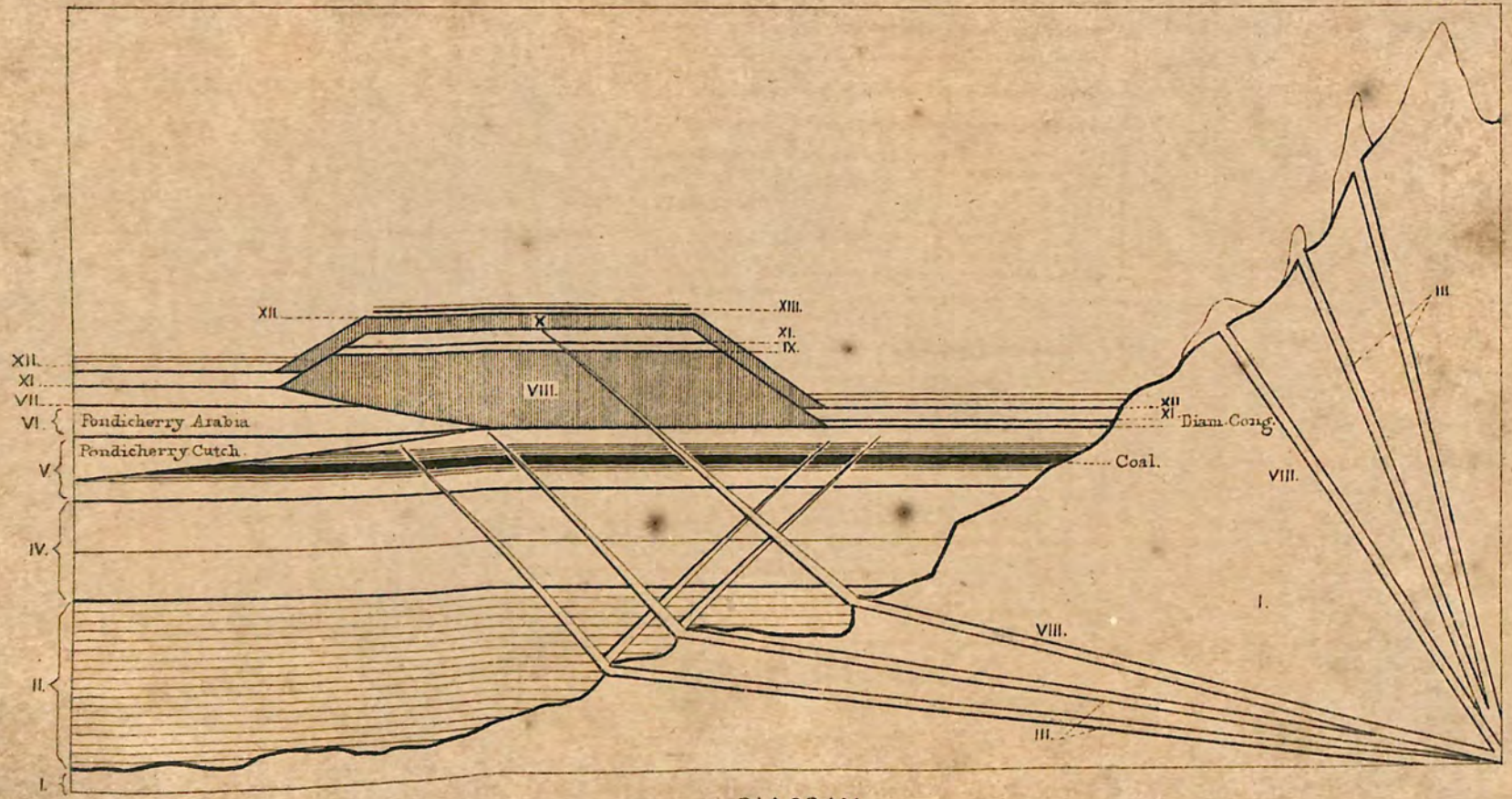
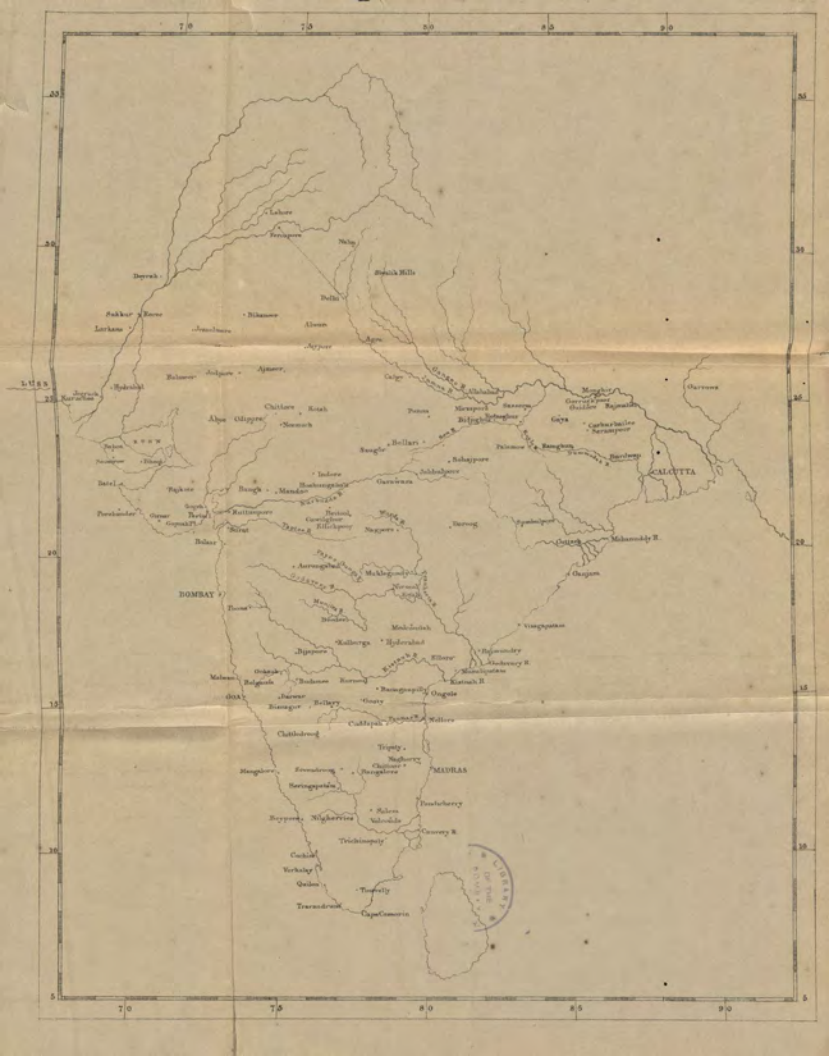



DIAGRAM.

For explanation see Table p. 334.



Lahore
Ferozpore
Nalia
Simla Hills
Deyrah
Delhi
Sukkur
Rohri
Bikaneer
Lurkana
Jeanolmore
Alwar
Agra
Jeypore
Balmeer
Jodpore
Ajmeer
Calgy
Ganges R.
Jumna R.
Allahabad
Mongbir
Gorruckpore
Goldore
Rajmahal
Garrowa
Jeerruck
Kurrachee
Hyderabad
Chittore
Kotah
Ponna
Mirzapore
Sasseepore
Bidjoghur
Gaya
Carbarbailee
Sarampore
Alpa
Odippore
Nemuch
Bellari
Sangor
Palamow
Ramghur
Burdwan
CALCUTTA
Sohajpore
Indore
Sohdeshpore
Garawara
Bangh
Mandoo
Rajkote
Porebunder
Gurar
Gopah
Rutlampore
Bertool
Cawalghur
Kilichpore
Nagpore
Darong
Sumbulpore
Surat
Bolaar
Cuttack
Mohanoddy R.
Aurungabad
Maklegondy
Ganjam
BOMBAY
Poona
Nirmal
Kotah
Mandoo
Bhoolee
Mokondah
Vizagapatam
Kolhurga
Hyderabad
Bijapore
Rajmundry
Godavery R.
Ellore
Mozulipatam
Kistnah R.
Malwan
Bulgaria
Budamee
Kurnool
Ongole
GOA
Darwar
Bellary
Gooty
Bisnagar
Cuddapah
Nellore
Chittledroog
Tripaty
Naghorry
Chittoor
Mangalore
Sevendroog
Bangalore
MADRAS
Seringapatam
Pondicherry
Salem
Beypore
Nilgherries
Valcondo
Cauvery R.
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Cochin
Verkalay
Quilon
Tinnevelly
Travancore
Cape Comorin
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*Private Manuscripts.*

Bell, Dr. T. L., H. H. Nizam's Service.
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Cullen, Major General, Resident, Travancore.
Constable, Lieut. C. G., Indian Navy.
Nicolls, Capt. W. T., Madras Army.
Taylor, Capt. Meadows, H. H. Nizam's Service, Deputy Commissioner of the Western Ceded Districts.

* Mr. Fraser's paper in the Geol. Trans. Lond. 4to, New Series, Part 1 of vol. v. I have not been able to obtain.

## ART. III. — *Description of the Caves of Koolvee, in Malwa.* By E. IMPEY, Esq., Residency Surgeon, Indore.

Presented 19th May 1853.

THE discovery of another series of Budhistical caves in Central India, in the neighbourhood of Ujjayuni, is not perhaps so much matter of surprise, considering the Budhistical tendency for so many centuries of Avanti, the country of the great Asòka's conversion and reign, as that they have been so long undivulged and undescribed, though within a few miles of a military cantonment.

Their existence cannot be said to be altogether unknown; for notwithstanding their situation in the wild district of Soandwara, every village within several miles round proves to know them by name; but this only tends to show how much may be brought to light when diligent inquiry is set on foot, and that it is only by such means, perseveringly or systematically pursued, that what are termed discoveries are made, and hidden, but still patent, treasures revealed.

Few things are perhaps so much to be regretted, as that the exigencies of the service, or rather the financial requirements of the State, should have led to the arrest, or certainly the curtailment, of the enlightened views and directions of the Honorable Court of Directors, regarding the record by means of illustration and description of the different architectural and antiquarian remains that are known to be spread over India. Were the commission for this purpose at work organized, as sketched out by the Honorable Court, their labours, extensive as they were intended to have been, must still reach beyond the limits of delineation, and embrace and end in many discoveries, and, which is quite as important, the correction of many descriptions of antiquities, literally and faithfully given, perhaps, but artistically and critically deficient.

Instead of deterring from notice, the likelihood of such a body being at work appears to me rather an incentive to accuracy in detailing unknown objects, for few have the opportunity of acquiring knowledge on these points by personally comparing the antiquarian remains in

the different parts of India, and fewer still the inclination to enter on it, though in the Transactions of the Societies of Bombay and Bengal, Colonel Sykes' notes, Dr. Wilson's researches, and Mr. Fergusson's works and plates, something more than superficial knowledge may be acquired.

Central India, as defined by Sir John Malcolm, having Bundlekhund and Guzerat for its eastern and western boundaries, the Hurowtee and Vindhyan ranges for its northern and southern, has been the centre of as many religions as dynasties; and though the limits above given are still retained by the paramount power for political reasons, the tract geographically considered has very much larger scope.

If the limited portion, or Malwa, can claim from Vikramajit a Brahmanical association almost syncronous with our era, it can also enumerate among the records of its creeds that of Budha, two centuries previous, in the person of the great Asòka, while several centuries after, Raja Bhoja and the Jains re-established the same religion in a different and corrupted form, and were still later succeeded by the Mussulmans in the eleventh century A. D.

Each of these persuasions have left in the country ample records of their existence; the Budhistical being, however, the most difficult to fix with any certainty, both from their greater antiquity and the absence of inscriptions or other insignia than the structures themselves, which are useful for the purpose of chronology only by comparison with similar or co-eval buildings elsewhere.

More is unnecessary in this place than an enumeration of the latter mentioned, and foremost of these is the great Sthupa (in the country termed Bittha) at Sanchi, near Bhilsa, with its elaborate and singular gateways and balustrade, its attendant tumuli and the detached but inferior ones, amounting to six or seven on the Jinea hill, about 6 miles distant, and, if I mistake not, a few minor ones at Gyaraspore, 20 miles to the eastward; all these have been recently opened by Major Cunningham, Bengal Engineers, who found, I believe, relics of different kinds, and as his work is about being published at the expense of the Honorable Court, the world will find at his hands a more critical notice than could be brought to bear on them by most archæologists in India.

The next Budhistical monuments of importance are the caves of Bàgh, in Rath, said to be four in number, but which I discovered to amount to eight, four of them large vihars, and also a second series much dilapidated. Except at Ajunta, and I doubt if even there, there is so continuously large a series.

Through the liberality of Mr. Hamilton, the Resident of Indore, I have a native artist employed in copying some paintings al-fresco, which I happened to hit upon on the conjoint exterior wall of two of these caves, and their completion will enable me to render a more intelligible description of them to the Asiatic Society.

The caves of Dumnar, near Chundwassa, fully 80 miles NNW. from Bàgh, were the only other set heretofore known, but I have now to add those of Koolvee, about 40 miles to the east of Dumnar, and I may mention incidentally, report of one at Ahoor within 15 miles of Koolvee, and one at Augur, 24 miles south. The latter I visited, and found that it had fallen in; there were in front evidences of four large plain pillars; the measurement along the rear wall was 24 feet, which was its width, the length being about 40 feet, it was diminutive in height, and the laterite roof had given way and tumbled in at the centre. It is now appropriated to one of the various forms of Vishnu, the trisool being stamped in several places on the red meaningless surface, which was thus converted and elevated into a divinity without "*form* or void" by the present race of Hindoos.

The Koolvee caves I visited first in December 1851. I was then, I believe, the second European who had been there, and they came to my knowledge through an accidental meeting with Captain Morrison, Officiating Political Agent at Kotah, who had joined the Resident's camp that year on its backward march to Indore, from a tour which had included the memorable Mokundurra Pass, and Holkar's stronghold and foundery, Hinglaisghur.

I consequently took an opportunity of the camp being in the neighbourhood to make a detour to the caves from Gungrar, the town and fortress so remarkable in the history of Malwa, and the annals of the Holkar family, for the exploits of the famous or infamous Toolseeah Bhaie, while in possession of the person of Mulhar Rao Holkar, and for the murder of Balaram Seth, events immediately preceding and conducing to the battle of Mehidpore, and the connection of the British Government with Malwa more immediately. I notice Gungrar thus prominently, because I there met in an open field a large erect slab, with a sun or chakra as an emblem, and below a lengthened inscription in a form of Sungskrit, of which I had a fac-simile taken, and as it is, I believe, for the first time made public, I send it to the Society for translation.

A hasty summons back to camp prevented my completing a report on the caves, and both on that account and a desire I always feel to

revisit a place of interest to test the record of first impressions, I made a second inspection of them.

They were first named to me as the caves of Kyesra, but I found it both a misnomer and misdirection, for they are close to, and overhang the town of Koolvee, 2 miles distant from Kyesra.

The nearest town of any importance is Dugh, longitude 24° E., latitude 76° 1′ N., it is the head of a purgunna, forming what is called the Chaomehlah, in the principality of Kotah, which passed to that State by treaty with us after the battle of Mehidpore; it is distant from Koolvee *vid* Malpore, about 6 miles, and visible from it. The other large towns near are Augur, 24 miles, Mehidpore 40, Ujjayun 60, Jalrapatun 35.

The hill in which the caves are, is isolated, perhaps 200 feet high; its general direction east and west, contrary to the axis of the hills around. Running all round it, but principally in the north and south faces, where the principal caves are, is a low scarp, nowhere 30 feet high perpendicularly, broken and split up by fissures and slips into irregular masses and projecting blocks. These conditions prevent anything like continuity being expected, or any height or magnitude to the objects.

The surface of the hill is flat, and the declivity below the scarp very gradual, and covered with brushwood of babul, behr, kuntar, &c. The only tree of any size being a tamarind, at the entrance of the temple, probably like them, the work of men's hands.

Geologically the formation of the hill is of laterite, of which a series of small hills extends SE. from Chundwassa, terminating at Augur, a stretch of 50 miles in length and 10 in breadth. The towns of Dugh, Augur, Barode, &c. are situated on it, the formation does not engage the valleys (where the black soil occurs as usual over Malwa), but the hills solely, capping basalt and trap, and it is the only instance of laterite that I have met so far westward. In substance it is very coarse, and in large fragments like conglomerate, or pudding stone, abounding in iron which imparts the colour to it. Such characteristics of course are ill adapted for minuteness of detail or fineness of execution, and with these disadvantages the selection of the hill would be unaccountable, but for the softness of the materials, and for its being, with the exception of Chundwassa, the only hill which has a scarp of any kind.

In many respects therefore, topographically, and as will be seen hereafter in other ways, the excavations at Koolvee resemble Dumnar, and these latter, I am inclined to think, have not received at the hands of

Colonel Todd or Mr. Fergusson the attention they merit. The antiquity assigned to them by both is open to question, but conceding this, and that they indicate a religion in a state of transition, such and their extent would demand for them more than a passing remark.

Colonel Todd seems to have concurred too readily in the conceited assumption of the caves by his Jain Gùrù, and transfers them at once to the Tirthankars; the only tangible cause, that I can see, being the presence of an antelope under one of the figures of Budh, but the same occurs at the Bàgh caves, which are unquestionably Budhistical, though of recent date; and Mr. Fergusson very quietly disposes of them in the 8th or 9th century A. D., sailing past them on his ship of the desert almost without a háil.

I hope, hereafter, in a future paper, to notice these caves of Chundwassa or Dumnar more leisurely, but at present, even while according to Mr. Fergusson all the credit he deserves for the enterprise and research he displays in his delineations of Indian antiquities, I cannot pass over without note the sneer he indulges in (in his "Illustrations of Indian Architecture") at the incompetency of the Honorable Company's Officers to acquire and understand what he has so quickly grasped, it would seem, from his aërey in the city of palaces.

His animadversions would lead the public to suppose that the servants of Government are not only grossly ignorant, but indifferent to the objects and subjects of ancient history in India; but I must claim for them this much, that it is to their unbidden exertions alone, he himself and the world at large are indebted for the principal knowledge extant regarding them.

The caves of Koolvee, besides their mere numerical amount, possess some striking peculiarities, among which are their simplicity and primitiveness, the isolation of the cells instead of their assemblage in a vihar, the absence of a chaitya or cathedral cave, daghob worship, conjoined with image adoration and decoration of the daghoba, which are, with one exception, in the open air.

They are cut literally round the entire circumference of the hill, and are about fifty in number, including the daghoba, but not the unfinished scratchings. Their chief aspect is to the north and south, the scarp being deepest at those points. There are amongst them six daghobas, exclusive of the largest and ornamented one, all of which are cut from the solid rock.

With the exception of two (the 9th and 12th) none are pillared caves, and even these, it is evident, are not excavated as vihars, but as shalas or halls of assembly; and although the general character of the

caves evinces the same religious sentiment, "cœnobitism," there would appear to be less of centrality and communism in it, in fact less corruption; the dwellings being nearly all single.

Immediately in connection with each daghob, here as at Dumnar, is one large cell for the chief Arhan or Thero, I presume, and these are generally vaulted, and with the usual stone-couch and pillow characteristic of these caves.

The dimensions of both the pillared caves are much the same, 32 feet by 24, oblong. In one, (No. 9,) the double row of plain square pillars is still standing. These are the shalas or assembly halls above referred to; they are vaulted length-ways, and at the extremity of the left centre is a recess of the usual shape and ornament of the place for a small daghob. One of these caves is subordinate to a daghob, which stands in a court-yard in front of it, flanked by an erect colossal figure of Budh, in the attitude of expounding, and the other to a seated image of Budh, which is in a cell opposite the porch flanked on the other side by diminutive daghoba in relief.

The rest of the caves are all solitary, in groups of two or more, attached as appendices to the daghobas or figures of Budh, the largest one being nearest to the object of adoration. Their peculiarities consist in there being in each cell a stone-couch and pillow, cut from the rock, usually in the verandah, and of the roughest kind; in the caves being vaulted, and lit by one or two small openings; and in their having an inner room leading from the verandah.

The cells generally are from 8 to 12 feet in length, proportionate to the intended occupancy, and seldom above 6 feet wide: the inner room, which is frequently lit by two slits, or openings into the verandah, is seldom above 6 feet square, and as there is no general plan for these dwellings, fancy or the softness of the rock would appear to have dictated their form.

The entrances to the verandahs are sometimes in front, at others at the extremities, and those of the inner cells either directly opposite to the outer one, or leading from a side passage. Their being lit invalidates the idea of their being store-rooms. Some have pillars at their exterior entrances, some interiorly; the largest single cell, 21 by 7, is at the rear of the chief daghob, and next to it the largest double cell, 27 by 7.

In workmanship, as in plan, these caves are of the most simple character, as simple as the wants of their tenant hermits, and though the adjuncts of the ornamented daghob and image prevent their being

reckoned coeval with these in Cuttack, their *tout ensemble* would place them earlier than any in Malwa certainly.

The daghoba of the series are also deserving of attention, from their size and number, and what would be styled *corruption*, but which admits, I think, of explanation on other grounds. They are seven in number, and the highest must have been from 30 to 40 feet.

They are all in the open air, and cut from the solid rock, and have indubitably been the great objects of worship, notwithstanding that the image of Budh is carved without and within them. In shape they differ from others only in being at present without a *tee* or umbrella, and not lengthened upwards with so many beadings, fillets, and subdivisions of these as are met with in those of modern execution, which make them look like turreted pillars.

The dome or cupola is supported generally by a circular frustrum, that rests on a square basement, their junctions being relieved by a few borderings. All, however, are distinctly connected with a figure of Budh in a sitting posture, which (when they do not occupy small recesses in the exterior) are placed in an excavation in the body of the daghob, a position unknown in the caves of Western India.

In the chief one, two pillars and a porch have (not been) added to the daghob, but form a part of the design, and it is besides profusely ornamented; this latter is not, however, diversified in the least, but everywhere a repetition of the same subject, which I take to be an outline of the daghob itself, between two plain pilasters. The daghoba are seldom solitary, and from this fact most likely successive in date; the four largest are within a space of 100 yards, the smaller ones in pairs.

The chief one, like the others, is cut out from the side of the hill. Its lower basement is 30 feet square, and 10 feet high, and above it rises a circular frustrum 10 feet high and 28 feet in diameter; and as the top of this is on a level with the tabular summit of the hill, the dome, *tee* and umbrella, if it had any, must have been constructed, and given it a maximum height of 40 or 50 feet.

On examining it closely, I found evidences of this in the shape of several large stones *in situ* on the top, bearing out the supposition, and a small square hole in the centre, evidently the bed of a support. The destructive hand of time, but more likely the bigotted zeal of the Mussulmans when holding the country, have conspired to leave but this remnant of the dome. That the latter is probable, I argue from the removal of the very large stones of which the dome was made, for the occurrence of any natural phenomena would have done more general

damage. As Koolvee is visible from Dugh, which, with other towns, have still the fortifications made by the Mussulmans, this cupola would have been a conspicuous object; and, except at Oonkar and Juggernath, not a single emblem of any religious faith escaped their ruthless and vindictive zeal.

Still the daghob at Koolvee is altogether the largest and most curious single one I remember to have seen anywhere. On approaching it from the west, and ascending the constructed parapet in front, and first setting foot on the chabootra, so formed, my first impression was that I had at last met a constructed temple of the Budhists; but a closer inspection induced me to regard it as a daghob ornamented, and Mr. Fergusson would say corrupted.

There is no interior, properly speaking, but a recess for a seated figure of Budh, about 8 feet high, in front of which a small porch is made to project, cut from the same rock as the daghob itself, and the plinths of the porch pillars being 3 feet lower than that of the base of the daghob, makes them look lofty, viewed in front from the landing place, which has been saved from the hill to create this effect.

It has at one time been plastered over, and the ornament is, to my thinking, a diminutive daghob, within an archway, with pilasters at the sides flanked by similar arched decorations.

I cannot help imagining these are mere outlines of a daghob, and adapted for such purpose by a few curvatures and ornaments, and it strikes me still further that such is the origin of the pointed decorative arch of the caves and of the great *windows* of the cathedrals at Ajunta, Karli, and Keneri. I do not mean to view the arch in its constructive or architectural light, but as simply designed and suggested from a type, familiar to the Budhists in their daghoba; at least the outline is precisely alike.

Though dug from the hill, two sides of the large daghob only are free, that with the image and porch and the adjoining outer side at right angles to it, and furthest from the hill which, save in the porch, is the counterpart of the other. That nearest the hill is separated from it by a passage which leads to the large single cell before mentioned, and the other has had a frieze or screen cut on the side of the hill opposite to it, of the same character as the daghob, viz. alternate small daghoba and the ornament. This being visible from the approach up the hill, may have been considered in keeping.

Daghob No. 2, instead of a porch, has a vaulted excavation, for the image; No. 3 is the most remarkable of the series, and suggests another idea, that it is the original and type of the chaitya caves

improved on at Dumnar, and brought to perfection centuries later at Karli and Ajunta.

The daghob is here within a long ovoid cave, intended and cut for itself solely, 21 feet by 16 ; it has neither ribs, aisle, nor gallery, but an open doorway. The image is enshrined in the body of the daghob, which is prolonged forwards, and the sides terminate in pilaster-like fronts, surmounted by small daghoba, and charged with two erect warders below, and two small seated figures of Budh above them. I rather think this was done as an after-thought to protect the deity ; for the roof appears to have fallen almost during the excavation, the crust being very thin, and to this miscalculation very likely this addition is attributable.

The decorations of the daghob generally are only of any moment as indicative of the idea they embody, and the execution and progress of art they evince, and certainly very little can be said in either respect, whether as to novelty or variety. The ornament of the basement of the large daghob, the screen in short wherever seen, is a mere repetition of the same notion, and I take it to be, as said, an outline of the daghob between simple and plain pilasters.

The execution is as good as the nature of the stone admitted. Of ornamental figures there are none whatever, and those of Budh, with one or two exceptions, are seated cross-legged on a sinhàsa. The roughness and coarseness of the stone, and its disintegration by the weather, render it very difficult to say what the figures may have been originally, artistically viewed.

There appear to be no records connected with them in the shape of letters, pictorial or other illustrations, and no fabulous history (not even of the Pandus) within the knowledge of the present race of Natives who live near. All I could elicit as to their structure resulted in the happy conjecture that they were the work of gods, not mortals.

From the above data and descriptive detail there remains to be drawn the important deduction as to the antiquity of these caves. In many points they bear a strong resemblance to Dumnar, viz. in their size and height ; in short, what may be termed their physical character ; and the analogy is carried somewhat further, and embraces a similarity of worship, that of the Daghob, and in decoration ; but the caves of Koolvee have no chaitya or cathedral cave, the daghob being in the open air ; there is no attempt at a vihar, as intended in Bheem Singh's bazar, at Dumnar, and no emblematical or mythological figures, as the antelope ; they are consequently of anterior date.

Mr. Fergusson places the Dumnar caves in the 8th or 9th century, and makes the remark from their want of "simplicity and majesty, that it only requires sufficient familiarity with the degree of downward progress to be enabled to use it as a graduated scale by which to measure the time that must have elapsed before the most perfect could have sunk into the more debased specimen." This is doubtless true to some extent, though a state of perfection implies an epoch of time, as it is against reason to suppose that art could have sprung at once to positive excellence; but it is not easy to reconcile simplicity and majesty, where both material and size are against the sculptor.

It seems to me, however, that these caves leave with the beholder a perfect equivalent for the want of finish in the primitiveness of their design. The figures are all simple; the daghob, with one or two exceptions, the same; while the absence of a cathedral cave, or, to give another definition, a finished receptacle for the daghoba and its manifest worship in chief, confirm their antiquity. To add to this, there is no grotesqueness or disproportion apparent in the remains of the figures, no flying figures, Budhsutwas or subordinate divinities, and the only semblances of corruption are the alterations and additions in the daghoba, which may be accounted for in my estimation.

The Budhists in Malwa had before them but one form or type to regulate their worship, embody their faith by, and to guide them in the utterance of their creed; that was the great Sthupa at Sanchi, which I venture to say will turn out to be the Chaityagiri mentioned in the Mahavanso erected by King Asòka's wife, and visited by Mahindro their son, on his way from Oojein, (prior to the conversion of Ceylon,) and from which he is said to have sprung. This would place it in the 2nd century B. C. Its form has naturally given the character to all their after-sculptures, and originated the daghob a century or two later. An image of Budh was afterwards placed at the cardinal points in connection with it, and still later, the gateways and balustrade were added, as evidenced by the gifts towards them, in a language which has evidently undergone change.

The figures of Budh at Sanchi are seated and squatted, and the remains of pillars exist, showing that a canopy was over him.

The latter Budhists, a century or two afterwards, in copying from this in the rock, and finding the necessity to enshrine the deity somewhere in connection with the daghob, and working on the solid rock, but still in the open air, would naturally excavate a place for it within the daghob, to protect it from the vicissitudes of the weather, or have a portico in imitation of that at Sanchi, and I am inclined to think

that No. 6 daghoba, thus hollowed out from the hill, was the first attempt at having one in a cave, which was further improved on at Dumnar, where the cave was lengthened, the daghob placed at the end, and the light admitted by two lofty verandahs, the outer one higher than the inner; this being afterwards replaced by the more perfect chaitya-shaped window at Ajunta and elsewhere.

The worship of the image is thus scarcely inferior to that of the daghob itself; more properly it is associated with it. Altogether I incline to think these caves were the early attempts of the Budhists at caves in the 3rd or 4th century A. D., the second era of Budhism of Malwa.

Were they of the 8th or 9th century, there would certainly have been more perverted ornament, or some copy from the Brahmanical decorations which pervaded both the Budhist and Jain architecture at that period; but there seems no variety in it, and it almost compels the conclusion that what is seen is original. The pillars evince the same, being plain and square with the abacus merely lineally rounded.

The ornament is figurative, resembling the outline of the windows of the cathedral caves, and is the same at Dumnar and Bàgh. As it may be interesting to notice the embellishments this self-same decoration has gone through, I give in juxtaposition copy of a Budhist one, and also one from the Jain temple at Gyraspore, and from the Brahmanical monolithic temple at Dumnar. Any argument from so insignificant a part of a building as a mere decoration is not likely to be material or to justify a rational conclusion, but it is well worth while noticing it *en passant*, and remarking that had the caves been near the period of the richer one, or had the architects been Jains, the resemblance would have been closer, and partaken of its character.

In one or two cases the figures of Budh were alone in a small sanctuary for itself, but their position with reference to the other caves was so irrelevant and misplaced, that they must have been after-conceptions and posterior in date, which I take to be the rationale of the unfinished caves, which do not number half a dozen.

The following is the description of the caves in numerical succession:—

No. 1.—A single cave, 21 feet by 7, leading from the passage at rear of the large daghob. It has a stone-couch and pillow at each end; the inner room is large, the doorway being two pillars; it is dark and gloomy.

No. 2.—The largest combination of the cells opposite the landing-place, and close to the chief daghob. It is 28 feet by 7, in the shape

of a ⊥ inverted, with side rooms from the passage; it has a triangle over the door.

No. 3.—A flight of steps at the outside, and furthest extremity of this, leads to a cave over this, unconnected with it, but of corresponding length; nearly at the end are a couple of pillarets for windows, the hill projects over them admitting the light from below, but screening the verandah from the weather. There is a stone-couch near this window. The inner room leads off from a side passage, also furnished with a couch.

No. 4.—A large daghob by itself, in the open air, with a recess in its base for a figure of Budh.

No. 5 consists of a long vaulted verandah, entrance at one extremity. At the other, a small room with two windows, and a resting-place; in rear is one room, with a stone-couch in the passage.

No. 6.—The vaulted cave for the daghoba, 21 feet by 16 and 12. The roof has fallen in, and the daghoba is prolonged forwards, ending in fronts, on which images of Budh are seated over erect darpals. There is a passage round the daghob, which has a tee and double umbrella over it. The excavated portion of the daghob contains a seated figure of Budh colossal, the doorway is capped by two small daghobas. This is, I imagine, the origin of chaitya caves.

No. 7.—The cell of the attendant on the above, which is larger than ordinary ones.

No. 8.—A large daghob, 12 feet in diameter, cut from the solid rock. It stands in front of a small court 22 feet by 8, one side of which is occupied by a colossal figure of Budh, 15 feet, his right hand extended and expounding.

No. 9.—A hall or chankman, 32 feet by 24, containing a double row of plain pillars, and vaulted roof, leads from this court. One-half of the doorway before the small pillars is cut away, and the other was probably meant to be enlarged also for light, which the daghob in front blocks out; on the outer pillars is the curious inverted crescent figure noticeable in almost all Budhist caves, Keneri particularly. Above the short pilasters is the usual characteristic ornament; the doorway is 12 feet high and 4 broad, and required the additional 4 feet below for light.

No. 10 has two rooms from a verandah, in which is a large hole dug; the entrance of one room has two pillars to it, the other is plain. It is the attendant room to No. 9.

No. 11.—Entrance at the end, with a window and couch. Steps lead up to the hill between this and the above; they are now broken considerably.

No. 12.—A pillared hall, same size as No. 9; has a porch like the large daghob; a frieze along both it and the front above the windows similar to the ornamented screen of the same; the windows are small square openings; the court is flanked by daghoba in relief, and the image of Budh is in a smaller cell opposite the porch. The entire roof has fallen in, so much so that it escaped my observation on my previous visit.

No. 13.—Two caves, one a single plain cell, without verandah, and opposite it an image of Budh in a cell also. It is observable that all the figures, however met, are under cover; if connected with the daghob they are placed in a hollow *in it*, if single or unconnected they are protected by a cell.

Nos. 14 to 22.—A range of 7 cells, plain, without verandah, or inner room or couch; in rear another figure of Budh facing outwards.

Nos. 23 to 26.—A series of three, parallel to one another, and a figure of Budh, which seems an after-idea. They are double cells with verandah, resting-places, or rooms, separated from one another by narrow passages; at the extremity of one of these is the image in a cell.

No. 27.—Two daghobas in a court in the air, cut from the hill.

No. 28.—The image, too large to admit of being placed in conjunction with them, so put into a cell adjoining, strongly marking the inseparability of both.

No. 29.—The poojaree cell, attendant as usual on the object of worship.

Nos. 30 and 31.—A large double and single cell, extending up a long passage cut in the rock, opposite the furthest; a figure of Budh in a cell.

No. 33.—A vaulted cell, with verandah, but with a large arched fronting, evidently begun for some other purpose; bears marks of having been plastered over.

No. 34.—A long vaulted chamber, too small for any purpose but a dwelling.

No. 35.—An ordinary habitation of two rooms, entrance at the extremity.

No. 36.—Approachable from above, two rooms with an open verandah and bench outside, the sun being seldom on this part.

No. 37.—A long large cell, cut high on the rock. It has a parapet in front, and a door and six rude windows; an inner chamber runs backwards from one end, entered by two pillars, and another at an angle with that. There has been a large platform for walking about in front

of this, which has now fallen. A vaulted chamber has also been commenced underneath; a flight of steps lead up to the hill from one extremity of this.

The series is here terminated by the cessation of the scarp, but is continued a little further on.

No. 38 is a cell which has lintels cut in the doorway, which none of the others have; the stone bench is outside, excavated grotto-like.

Nos. 39 and 40.—Similar to the above; the rooms being vaulted.

No. 41.—Two rooms and a verandah; door being lintelled, as all seem to be in this range.

No. 42.—Cut high on the hill, and approachable only by a ladder, like 37; there is an attempt at windows; the door has a regular arch, the windows half arched; a recess leads off from extremity.

No. 43.—A daghob, with dome broken, in a court; has a receptacle for the image projecting from the circular frustrum.

No. 44.—The attendant cell to 43. The next is the great ornamented daghob.

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## Art. IV.—*Descriptive Notices of Antiquities in Scinde.* Communicated by H. B. E. Frere, Esq., Commissioner in Scinde.

Presented at different periods.

### Cairns and Cromlechs.

"4. Mr. Macleod, Deputy Collector, informs me that cairns and cromlechs, such as are described by Captain Meadows Taylor, are common on the road to Shah Billawal, in Beloochistan, and also in the hills on the direct road from Kurrachee to Kotree. They are generally known as "Kaffirs' graves," and are attributed to the "Wudwas," as described by Captain Preedy. The name has been variously explained to me as meaning the "great" or the "old" people. The Hindoos claim them as Hindoos, because they buried their dead with their heads to the east, and were therefore clearly not Mahomedans. But they

could give no other reason, nor could I hear of any images or Hindoo emblems having ever been found near the graves. Tradition states that their capital was "Hubb Sarona," some distance beyond Shah Billawal, and that they worked the lead mines at Kundroj, 12 coss from the latter place; that theirs was an older city than Beila, which boasts a history of 3,000 years. Their tombs, as found thereabouts, are circles of slabs of stone, placed upright, and consist, sometimes, of several chambers, connected together. The last of the race, it is stated, were rooted out, and destroyed by Mahomed bin Cassim, when he conquired Scinde. Pieces of their money are sometimes found near the sites which the Wudwas are said to have inhabited, but they are simply squares of copper, about the size of a pice, without stamps or mark."—*Extract of letter* 1841 *of* 1851, *from H. B. E. Frere, Esq., to the Government.*

"3. Throughout the hilly tract which extends from Capo Monze upwards, and which forms the western frontier of Scinde, traces of an ancient people, distinct from those of the Soonnahs and Summahs, found in the valley of the Indus, are apparent. These are usually found most numerous in the vicinity of natural springs, and consist of stone enclosures, wells, cromlechs, caves, cairns, and graves or barrows, of unusually large dimensions.

"4. *Stone Enclosures.*—These are numerous, but the three principal ones which I have observed are situated, the first near Kurrachee, the second near Dunraj, on the direct road to Sehwan, and the third in the valley of the Hubb, near the village of Oomed Alli Chootah, about 100 miles north of Kurrachee.

"5. The first is situated near the Kurrachee cantonments, and when I first observed it, some twelve years ago, its external walls were about 3 feet high. At present merely the foundation remains, the stones having been carried away by camp followers for building purposes. The plan of the enclosure is, however, still distinctly visible.

"6. The whole of these enclosures face east and west, and are constructed of large unhewn stones, piled together without cement: they are in the shape of a parallelogram, and are usually divided by transverse walls into several departments. They vary in dimensions, that near Kurrachee being 112 paces in length by 15 in breadth, the one near Dunraj about half that size, and the third, near Oomed Alli's village, being still smaller. The first is divided into seven apartments, the second into three, and the third has no division at all. The first is known amongst the natives by the name of the "Sath Ghur," or seven houses. The traditions, or opinions rather, held by

the natives of Scinde, regarding these and the other ancient remains, are various. Some, amongst whom was Nuwab Ahmed Khan Noomujah, informed me that the enclosures were erected thirteen centuries ago by the 'Wudwa Log,' of whom nothing certain was known, except that they were either Jews or Kaffirs, and that they were driven out of the country or extirpated by the Prophet's son-in-law Alli.

"8. *Cromlechs.*—These are not numerous; indeed the only one which I have observed is situated a few yards in front of the stone enclosure near Dunraj. It appears originally to have consisted of four stone altars, each composed of four upright stones of large dimensions, with a large flat slab on the top. The altars are erected in an enclosure of unhewn stone, which is built in an exact square, each face of the square fronting to one of the cardinal points. The square is equally divided into four parts, in each of which is erected an altar. The entrance to the enclosure is in the northern face. The whole of the altars are more or less injured; but I am not aware of any excavations ever having been made to ascertain what is deposited beneath them.

"9. *Cairns.*—These are piles of unhewn stone, varying from 6 to 10 feet in height. They are very numerous, and are said by the Scindees to be of modern erection. The Natives call them 'Chors,' and report that they are erected, when found singly, to commemorate the site of some private murder, and, when found in clusters, to mark the battle-fields, and the numbers slain in engagements which have taken place in former years, between the several nomadic tribes inhabiting the hills.

"10. *Gravi, or Barrows.*—These are frequently met with, either singly or collectively, and are always spoken of by the Scindees as the graves of the former Kaffir inhabitants. They are found most numerous in the vicinity of the hot springs. They are usually covered with large loose stones, and are about 2 feet in height, 8 or 9 feet in breadth, and from 15 to 20 feet in length. I am not aware that any of them have ever been opened; but I purpose opening some of them during my next tour, and hope to report the result. The valleys of Naing and Kahee, in the Janghar purgunnah of Sheinstan, appear to have been the head quarters of this ancient race. Both valleys are watered by beautiful and copious springs of water, which, rising considerably above the level of the valleys, rush down on the fine alluvial plains below, affording an abundant supply of water all the year round for the cultivation of four or five hundred acres of land in each valley.

"11. The graves are most numerous in the valley of Naing, where I also discovered a rude kind of tope, of which I beg to annex a rough

sketch. It stands on the top of a small limestone hill, in which the spring which waters the valley has its source. It is constructed of large unhewn stone, put together with much regularity, but without any cement. The Nohannee tribe of Beloochees, who inhabit and cultivate the valley, state that it is erected over the heads of a vast number of their tribe who were slain in battle, when opposing a detachment of troops sent against them from Delhi under the command of a certain Nuwab. They have, however, no tradition as to when the action took place, and the Nuwab's name, if he ever existed, has long ago perished.' I am decidedly of opinion that the tope is much more ancient than the Nohannee Beloochees, and I hope, on my next visit to the spot, to open it, and to ascertain its contents. Judging from its appearance, it has never been disturbed since its erection. The dimensions of the tope are as follows:—Height of the lower story 7 feet; ditto second ditto, 6 feet; ditto third ditto, 3 feet.

"12. Each story is circular, and apparently solid, the lower one being 12 feet, the second 6 feet, and the third 3 feet in diameter. There is a flight of steps in the eastern face, leading up to the top of the first story. I could discover no inscription on any of the stones.

"13. About 300 yards in front of the present village of Naing, a conical-shaped hill rises about 100 feet in height: it is very steep, and appears to have been fortified at some distant period. A winding pathway leads to the top, on which is found one of those enormous graves or barrows which I have before described. The foundations of walls are also apparent, and some modern graves. Tradition reports that this was the stronghold of the Kaffir chief whose name was Luckmere; that he here made his last stand, and, being overcome and slain, was buried here. Noor Mahomed Kullora intended to have fortified the neighbouring hills, where the spring has its source, and had gone to considerable expense in collecting stones for this purpose. Vast quantities of stone still remain piled up in heaps at convenient distances for the workmen when they should commence building. The Meer died before he could carry out his project.

"14. *Caves.*—In the valley of Kehm, at a short distance from the spring head, there are several rude caves hewn out of the rock, which have evidently been used as human habitations, though now used as cattle sheds. These, also, are ascribed to the former Kaffir inhabitants. There is a small cave between the town of Sehwan and the bunder, called the 'Ek-thamb,' or one pillared, which was visited by Dr. Wilson, and is noticed in his 'Memoir on the Cave-Temples, &c. of Western India.' This is supposed to be of Hindoo origin, but it would seem

that the ancient race whose remains are found in Scinde, and which I have attempted to describe, were not Hindoos, as the former buried their dead, and would appear to have had amongst them none of the Hindoo symbols—at least none have as yet been discovered."—*Extract of letter* 2060 *of* 1851, *from Captain Preedy, Collector, Kurrachee, to H. B. E. Frere, Esq.*

"2. Owing to the long-continued drought, the hill districts are almost deserted, so much so, that on my route from Kurrachee to Janghar I seldom met with even a solitary goatherd, except in the vicinity of a natural spring, of which several are found in the valleys. All these springs are hot, the temperature of them varying from 100° to 110°. In the valley of Longa, a spring rises at the extremity of an extensive plain, of which it waters about 300 beegas. This land is included in the jagheer of Nuwab Ahmed Khan Noomujah.

"3. Two other fine springs, called Kahee and Naing, rise a few miles to the westward of Janghar. The former fertilizes about 200, the latter about 400 beegas. The lands watered by both these springs are cultivated by the Nohannee tribe of Beloochees, the former on account of Government, and the latter on account of Kumber Allee Syed, Jagheerdar. The vestiges of an ancient people are observable in the vicinity of both of these springs, and also in many parts of the hills. These consist of rude stone enclosures, usually in the shape of a parallelogram, varying in length from 50 to 100 yards, and in breadth from 10 to 20 yards. These are constructed of rough unhewn stone, piled together in regular order, but without cement. The enclosures are generally found about 3 or 4 feet in height. They are divided by partition walls, of the same material and thickness as the outer walls, and usually face east and west.

"4. Near the springs at Kahee there are several rude caves hewn out of the rock, which have evidently been used as human habitations. They appear to be of great antiquity, but tradition is wholly silent as to who the people were that inhabited them."—*Extract of letter dated 24th November* 1849, *from Captain Preedy to H. B. E. Frere, Esq.*

"2. The cross-shaped erection described in the 7th paragraph of Mr. Macleod's letter is the same as that which I have described as a square of four stone altars. It is situated about half way between Truck and Dunraj, on the direct route to Sehwan.

"3. The stone graves alluded to by Mr. Macleod are found in great numbers throughout the hilly district which extends along our western

frontier. They are usually met with in elevated positions, and consist of three or four large stones set on edge, with a flat stone placed horizontally on the top. There would appear to have been no uniform rule observed as to the direction in which these graves were placed, as in the groups I have met with they are found in all directions. I had the pleasure of pointing out one of these groups to you a few days ago, on the hills near Waghodur, and I think we both agreed, that with the exception of the hole in one of the side-stones or walls, the graves exactly resemble those described by Captains Taylor and Congreve, and we are, I think, therefore, justified in regarding both as the remains of the same Scythic Druidical race."—*Extract of letter* 2154 *of* 1851, *from Captain Preedy to H. B. E. Frere, Esq.*

"2. With reference to the Commissioner's instructions on this subject, I have the honour to submit to you, for his information, that no ancient remains of the precise nature adverted to by Captain Meadows Taylor have come under my observation since my arrival in Scinde in 1843. There are some objects of interest, however, to the antiquary, which, as they are distant from the scene of my labours, I will take the liberty of mentioning to you, that the attention of others whose duties may admit of visiting and describing them may be directed thereto.

"3. In the hill country west of the Indus, graveyards far from human habitations are frequent. They are the burial grounds of particular tribes and families, to which the dead are brought, at times from a considerable distance. In such places certain graves are pointed out as those of Kaffirs; they are generally well defined, with large stones set on edge, and are easily distinguished from the more modern graves of Mahomedans. These are in all probability the graves of the inhabitants previous to the Moslem invasion.

"4. In sequestered spots, clusters of somewhat similar memorials of the dead may be found without any admixture of Mahomedan graves: they consist each of four stones, forming a small square, within which particles of calcined bones may be observed. Occasionally they are arranged in a circular form around a few, which form a centre. I may mention that between Run Pittana and Moulmacharee, in the direct road between Hydrabad and Kurrachee, is a small valley, formed by the cliffs on one side, and the hillocks on the banks of the river on the other. These remains are numerous.

"5. Scattered over the hill country in every direction, enclosures of stone, called by the Natives 'Kaffir Kote,' are to be found. What

they may have been I shall not attempt to conjecture; they are of too small a size for dwellings. Some of these may be seen on the right bank of the Gugger river, in the bed of which an inscription is reported to have been observed, in a strange character, by one of the Surveyors attached to the Chief Engineer.

"6. At Jhareejah-ka-Bootea, between Jokundee (an extensive burial ground of the Jokeeas) and the Guggur river, is a bund, composed of large unhewn stones, which was apparently made when the country was more thickly populated, and the people more industrious than at present. It is called 'Bamdelleo,' and the 'Kaffir Bund.' My inspection of it was a very transient one, but I have an impression that it is the monument of a remote era, and, in connection with the former history of the province, is worthy of the attention of the antiquarian.

"7. Near the village of Truck, on the direct road from Kurrachee to Sehwan, is a remarkable erection, not, I think, of modern date. It is composed of a double row of upright stones, and is in the form of a cross, the arms being in the direction of the cardinal points. The top is yet in part covered in with large stones, the length of which may range from 6 to 9 feet.

"8. Monuments elaborately carved are common enough; but they are all of comparatively late date, and may easily be distinguished by the head lying a little to the northward of west, which is in Scinde the supposed direction of Mecca."—*Extract of letter 262 of 1851, from J. Macleod, Esq., to H. B. E. Frere, Esq.*

*Budhist Remains near Jerruck.*

Sir,—I have the honour to inform you that I have forwarded to the Society two boxes containing specimens of terra cotta architectural ornaments, dug up in the neighbourhood of Jerruck on the Indus, and presented by W. Cole, Esq., Deputy Collector of Kurrachee. (Plate vi.)

2. They appear to me to be extremely interesting, for more reasons than one.

3. As mere specimens of ornamental brick-work, they are of a style superior to anything now to be seen in Scinde; but their chief interest consists in the great apparent antiquity of the building to which they belonged.

4. I have seen no remains in Scinde to which a higher antiquity than the fourteenth century could be assigned on any clear and conclusive data. The castle of Sehwan is said to be very ancient, and so may be the Kaffir remains described by Masson, as well as the numerous

Hindoo shrines which have been converted into Mahomedan peers; but the claim of all these edifices to antiquity is conjectural or traditional, and not founded on any very decisive proof, such as coins, inscriptions, architectural remains of manifest antiquity, or on trustworthy historical testimony.

5. But the ornaments of the building discovered by Mr. Cole appear to me to be clearly Budhist; and unless I am mistaken in this belief, they would give very high antiquity to the building to which they belonged.

6. All the ornamental parts strike me as very similar in character to those found in the later Budhist cave-temples; and fragments are found bearing the figure of Budha, sitting in the attitude of contemplation. The head is invariably cut or broken off, probably by the Mahomedan Iconoclasts who destroyed the temple; but the large pendulous ears and other characteristics of Budha are still clearly traceable. One of these fragments will be found in the boxes now sent.

7. Some of the ornaments are stamped; others appear to have been cut while the clay was soft; and the patterns are of great variety. Those now sent are only a selection.

8. The spot where the remains were discovered is a low hill overlooking the Indus, about 3 miles below Jerruck, and close to the hamlet of Shaik Taroo.

9. It was pointed out to Mr. Cole as a "Kaffir Kote"; the only local tradition was that it was the residence of "Munjeera," an infidel king, who reigned before the Mahomedan invasion of Scinde.

10. The flat top of the hill, (pl. v. fig. 1,) which is of small area, appears to have been formerly surrounded by a wall of large stones, the remains of which are in places still traceable. A projecting portion at the east side appears to have been separated by a wall still traceable by a raised ridge of loose stones and rubbish; and there are traces of stone enclosures inside, the character of which may, perhaps, hereafter be discovered, when the rubbish which covers them has been removed.

11. Outside of the part thus cut off from the rest of the hill are the remains of three separate enclosures: those marked (*b*) and (*c*) on the sketch are, as far as has been yet discovered, rough stone walls; the mound marked (*a*) is that from which the ornaments now sent have been dug.

12. Mr. Cole's attention was attracted to the mound by finding a fragment of a very large and fine-grained brick, one side of which had been bevelled off. It struck him as unlike any brick he had seen

before in Scinde, and he employed men to trench across the mound. They soon came to the top of a wall, and, by clearing it down to the level of the surface of the hill, and following the wall, he exposed the remains of a building 85½ feet square, constructed of large and heavy well made bricks 15½ × 9½ × 2¾ inches, laid with very little cement, and that apparently the fine mud of the Indus, mixed, occasionally, Mr. Cole thinks, with some fibrous substance.

13. The base of the building was ornamented by a bold moulding, the character of which will be seen by the section (fig. 2). At intervals of 6 feet on the ledge marked (*a*) there were square projections, as if for pilasters.

14. The mouldings were made by rubbing down the large bricks to the form required.

15. With the exception of the moulding, none of the ornaments were found *in situ*. They were dug out of the rubbish which buried the remains of the walls, as though they had belonged to the structure above, and all bearing human figures had been defaced with some care.

16. Since writing the above, Mr. Cole has discovered an inscribed stone at a spot a few miles from the remains of the temple. It was lying about a quarter of a mile from one of the large square enclosures, built of unhewn and uncemented stones, of great size, which are commonly known to the hill shepherds as "Kaffir Kote." A description of one will be found in "Masson's Travels," and in some papers by Captain Preedy and Mr. Macleod, which I forwarded to the Society some time ago. I enclose Mr. Cole's copy (fig. 3) of the inscription, which may serve to identify the character. I hope to get one more exact when the stone reaches Kurrachee. The stone itself shall be forwarded if the Society would wish to have it.—*Letter* 1217 *of* 1853, *from H. B. E. Frere, Esq., to the Secretary B. B. R. Asiatic Society.*

*Ancient Remains of the Kurrachee Collectorate.*

Sir,—I have the honour to enclose a copy of a letter from Captain Preedy, with a sketch map in original, showing the positions of a number of ruins, apparently belonging to an ancient people who inhabited the hilly districts of the Kurrachee Collectorate. These remains are generally known to the present inhabitants as unbelievers' forts ("Kaffir Kote," or "Koteera," the diminutive of kote).

2. There are many of them identical with the ruins described in letters from Captain Preedy and Mr. Macleod, already transmitted (with letters No. 1841, dated 9th Sept., and No. 1960, dated 22nd

Sept. 1851—pp. 354, 355,) to the Society by Government, to whom they were addressed. Some of them are mentioned by Masson,* who gives a description and sketch of that one which stands No. 2 in Captain Preedy's list, and frequently notices others incidentally.

3. I have added to Captain Preedy's letter a ground-plan (pl. v. fig. 4, *a*) of that particular building of which Masson gives a wood-cut, and a few notes made during a journey through these hills.

4. With the exception of the small buildings described as roofed with slabs of stone, none of them bear any trace of a roof. If they ever had any, it must have been of such perishable materials as to leave no fragment now remaining.

5. The size and shape of the buildings, their frontage, and their frequent occurrence at distances of a stage or half a stage from each other, always along lines of road, and at good halting-places, impress me with the belief that they were built as shelter for travellers. Asóka is said to have ordered such buildings to be erected throughout his dominions, and, certainly, even without roofs, those described by Captain Preedy must have been very acceptable to travellers as shelter against the winds which sweep these dry and desolate valleys, in winter bitterly cold, and in the hotter months like the blast of a furnace.

6. The uniformity in the plan, materials, and mode of construction, *i. e.* huge blocks of stone, roughly squared, and laid without cement, go to prove, that whatever the buildings may have been, they were the work of one age and one people.

7. It will be seen from the map, that the lines of road from Kurrachee through the hills to Sehwan and Kotree are those on which these remains are most common. These routes are still much used by kaffilas from Khelat and Upper Scinde, and the number of travellers has much increased since the conquest of Scinde rendered the road safe, and freed the traders from the constant exactions of transit dues and black-mail. The population is now, and appears for ages to have been, almost entirely nomade. Even the few fixed inhabitants live in temporary huts made of reeds and boughs of trees, nor is any house of more substantial materials to be met with on this hill road for 140 miles, from Kurrachee to the Munchur lake. One considerable tribe, the Gubbools, between Pokrun and the Munchur lake, appear to live almost exclusively in caves and fissures of the rocks.

8. Yet the buildings described by Captain Preedy are not the only evidence of there having been once a fixed and more civilized

* Vide Masson's Travels in Beloochistan, vol. ii.

population. Rubble stone foundations, as of houses, often met with in considerable numbers, and built in regular lines, with fragments of pottery, testify to the existence of a settled people, who lived in permanent towns or villages, and who must have been much more civilized than the rude shepherds who now inhabit these valleys, and whose traditions hardly extend beyond the last few generations. It is remarkable that all inquiries for coins or other remains of the former inhabitants of these valleys, calculated to throw further light on their history or character, have hitherto been unsuccessful, with the exception of the inscription, a copy of which was forwarded with my letter No. 1217, of the 6th May 1853, (pl. v. fig. 3,) and which was found near the remains marked No. 16 on the map.

9. I have marked on Captain Preedy's map (by the word "Ruins") the sites of some of these vestiges of ancient inhabitants, which appear to mark the sites of former towns.—*Letter* 2109 *of* 1853, *from H. B. E. Frere, Esq., to the Secretary B. B. R. Asiatic Society.*

Sir,—In reply to your letter No. 56, of the 10th of January last, which I much regret should have so long remained unacknowledged, I have the honour to report that the following are the koteeras which have as yet come under my own observation.

*Obs.* 1.—Koteera means a small fort.

No. 1.—Near Kurrachee, containing seven divisions, called by the Natives the "Sath Ghur." The rooms or divisions are nearly square, and vary in extent from about 40 to 45 feet in length and breadth. The external and divisional walls are composed of large undressed blocks of stone, without cement, and vary from 6 to 9 feet in thickness. Many of the stones appear to have been exposed to the action of fire, and are burnt quite red. The koteera faces east and west, and each division has an entrance in the eastern face. These peculiarities are observable in all those yet discovered.

*Obs.* 2.—Vide annexed sketch [similar to figs. 4, *b*, pl. v.]. The rooms are about 30 to 40 feet, interior measurement.

No. 2.—Near Dumas, on the direct road to Sehwan, containing two or three (4?) divisions, each of about 35 feet square. The walls are constructed in the same manner as those of No. 1. Fronting east and west there is a curious cross-shaped building near this koteera, composed of huge perpendicular slabs of stone, with horizontal slabs above, which would appear to have been used either as a tomb, a temple, or an altar for sacrificial purposes.

*Obs.* 3.—This ruin is about 4 miles on the Dunraj side of Truck.

For a description and drawing vide "Masson's Travels in Beloochistan," vol. ii.. Annexed is a tolerably correct ground-plan (pl. v. fig. 4, *a*). The ruin is known to the Noomrea shepherds around as the "Sooseeke-Atun," or spinning-house of Soosee, the heroine of a popular Scindee legend, one version of which is given in "Burton's History of Scinde." Captain Preedy does not mention a single upright slab or rude obelisk still standing 10 or 12 yards from the NE. angle of the temple (?) or the remains of a similar slab at a similar distance from the SE. angle (*c*). The Noomreas have a tradition that there is in the neighbourhood a fine spring, which was purposely choked up and concealed by the "Kaffirs" when the true believers first invaded the country.

In the neighbourhood are two buildings of the same kind, not described by Captain Preedy, and which I have marked on his map as No. 2 A and No. 2 B. The former is between Ahmed Khan and Bhoola Khan's Tanda, and is a single room about 35 feet square, of the construction usual in these buildings. The other, similar in shape and size, lies between Bhoola Khan's Tanda and Soombuk, near the "Durwat," the pass by which the Bharun river escapes from the hills.

No. 3.—A large koteera on the Veroo plain, situated a short distance to the SW. of the bund. This koteera has seven divisions, is 125 yards in length, and 22 in breadth. The walls are similar in construction and dimensions to those of the "Sath Ghur."

No. 4.—A small koteera near the former one, of which only a portion of the foundations remains, the rest of the material having been removed and made use of by Captain Partridge in the construction of the large bund.

No. 5.—Also on the Veroo plain, distant about a mile from No. 3, with which it corresponds in length, but is deficient by 4 yards in breadth. The stones of which it is composed are also of inferior dimensions.

No. 6.—On the Veroo plain, distant about $1\frac{1}{2}$ miles to the westward of the bund. This is a circular koteera, with only one entrance, on the eastern side. The circle is about 10 yards in diameter, the walls about 4 feet in thickness, 3 inches high, and put together in the same manner as those of the quadrangular koteeras.

No. 7.—Between Rodh and Kotree, on the direct route from Kurrachee, containing three divisions, dimensions not recorded.

No. 8.—A small one near the former.

No. 9.—About a mile to the eastward of the two last, containing three divisions.

Fig. 1.




Fig. 2.




Fig. 3.



+ + + Indistinct letters.







Fig. 4.

*Obs.* 4.—Length (walls not included) 30 yards; breadth ditto 20 yards, divided by a wall into 2 equal parts, into each of which a door, situated 7 yards from either extremity, leads. Faces to the east.

No. 10.—Between Jerruck and Soombuk, near Loonee fort, on the Bahrun river, has two divisions. There is a curious stone altar near this koteera, composed of two perpendicular stones, with a large slab at least a ton in weight placed horizontally on the top of them.

No. 11.—Between Soombuk and Murrace, containing three or four divisions, dimensions not recorded.

No. 12.—Near Murraee, containing two divisions.

No. 13.—Between Kudjoor and Pokrun, containing two divisions; a circle of stones near it, divided by a cross of white stones, the limbs of the cross directed towards the cardinal points.

*Obs.* 5.—This stage from Kujoor to Pokrun is particularly rich in such remains. At Kujoor itself the stone foundations of a town or large village are visible, and thence to Pokrun are numerous vestiges of former habitations. The principal remains commence about 4 miles before reaching Pokrun, at the ruin numbered 13 by Captain Preedy. It contains two chambers, each 35 feet square. The circle is a little distance to the north, and is 25 feet in diameter.

About 150 yards further on is a koteera, containing a single chamber 35 feet square.

One mile nearer Pokrun is a very curious ruin, exactly the same in materials and construction as the square ruins, but consisting of two circular chambers adjoining each other, each circle 25 feet in diameter, and each with a doorway to the west.

One mile further on is another koteera, containing only a single chamber. This is about 2 miles from Pokrun, where there is a very large and perfect building, (No. 14 on Captain Preedy's list,) very similar to that near Truck (No. 2).

No. 14.—At Pokrun, dimensions and divisions not recorded. There are several small koteeras in this neighbourhood.

*Obs.* 6.—One of considerable size, and surrounded by marks of the foundations of houses is to be seen at Dull, the stage between Pokrun and Jungar.

No. 15.—In the valley of the Hubb river, near Oomed Alli's village, containing two divisions.

Nos. 16 and 17.—On the post road between Murree and Kotree, both small.

2. In addition to the above, I found several koteeras in the valleys

of Naing and Kahee, all of a rectangular shape, and possessing the usual characteristics as regards frontage, construction, &c.

3. In the valley of Nallie or Nurree, through which there is a mountain pass leading to Khelat, and by which kaffilas occasionally enter Scinde, I found two other circular koteeras, of similar dimensions and construction to No. 6. These were erected parallel, and a few yards distant from each other.

4. The above are all the koteeras that I have as yet met with, but there doubtless are many others to be found scattered throughout the hill districts on our western frontier.—*Letter* 1166 *of* 1853, *from Captain Preedy to H. B. E. Frere, Esq.; the "Observations" by the latter.*

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ART. V.—*Abstract of the Proceedings of the Society for the Year* 1852-53.

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## FOR THE MUSEUM.

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| Argillaceous Limestone, dark grey, and black, from the district of Shorapur, presenting on the exposed side excavations, conical inwards, from 0 to 1 inch deep, and 0 to ½ inch wide..... ... | Capt. M. Taylor. |
| Basalt, dark grey, brown, with spots of Olivine, specimens of, possessing a strong polarity, from the summit of the mountain called the Pouce, in the Mauritius..... ..... | Dr. G. Buist. |
| Bricks, mouldings and cornices from the remains of a Buddhist building, discovered by Mr. Cole in a mound 3 miles below Jerruck, on the Indus, Lower Scinde, bearing designs slightly allied to Grecian (?) style, viz. human figures, a running pattern of pelicans and the lotus with its shoots and leaves in the form of scrolls, lions' heads, the lotus by itself, &c. &c. On the surface of one brick is a figure of Buddha seated cross-legged on the lotus, with the hands in front of the lower part of the chest, and the little finger of the left between the thumb and forefinger of the right hand; a vest over all the body except the neck. Two rams erect, | |

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one on each side, their backs turned towards the figure; and two lions couchant under the lotus. Other figures appear to have existed on each side of the head, (crocodiles' mouths?) but they, with the head of Buddha himself, have been broken off ..... [Esq. H. B. E. Frere,

Burmese Manuscript on palmyra leaves..... Dr. J. Welsh.

Shells, containing *Physa Prinsepii, Paludina Deccanensis, Melania quadrilineata*, and *Cyprides*, specimens of, from the neighbourhood of Saugor, in Central India..... Captain W. T. Nicolls.

Coal, specimens of, from the Eastern Archipelago, viz. from Port Raffles, Northern Australia, Borneo, Islands of Lingui and Junkseylan, Indramayer Point on the North Coast of Java, Labuan, Sarawak, and Cumberland..... J. Ritchie, Esq.

Coins, Copper, (71,) bearing Arabic characters, from the Mahee Kanta..... Capt. R. Wallace.

——— (2,) with Devanagari characters on them, from Saugor, Central India..... Captain W. T. Nicolls.

——— Silver, (1,) discovered by Lieutenant Phillips in the ruins of the old town of Shakapur..... [Esq. H. B. E. Frere,

Cornelian, agate, and opaque blue glass, fragments of, from the ruins of Shakapur..... Lieut. Phillips.

Elephas Africanus, cranium of, without lower jaw and tusks..... Capt. Campbell, I. N.

Elephant, extinct species of alveolar processes of, with parts of the tusks *in situ*, from the banks of the Godavery at Pytan..... Dr. W. H. Bradley.

——— extinct species of, tusk and fragments of the long bones of, found in the bed of the Godavery, to which the alveolar processes just mentioned belong. The portion of the tusk is solid, and measures 7 inches in its widest diameter, while the hollow part in the alveolar process gives an arc of a circle which is 9 to 10 inches in diameter..... ———

Fossil-bones found near the village of Narainpur, 18 miles south-east of Saugor..... Captain W. T. Nicolls.

Fossil-bones of two extinct species of Elephants,

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| fragments of, from the Siwalik hills, consisting of 3 portions of the lower jaws, with more or less of a tooth in each, and 3 condyloid extremities of the large long bones ..... | Dr. G. Buist. |
| ——— of extinct animals, fragments of, from the island of Perim, opposite the mouth of the Nerbudda; consisting of 9 portions of the jaws of 3 or 4 species of mastodon; 3 portions of 2 species of rhinoceros; front part of the lower jaw of hippopotamus; fragment of a crocodile's head; 2 large vertebræ of proboscidian (?) animals; and 3 fragments of other bones..... | ——— ——— |
| ——— of extinct animals, fragments of, from the island of Perim, consisting of 12 portions of the teeth of mastodons; 6 portions of lower jaw, and one of the upper jaw, with teeth of 2 species of rhinoceros; one portion of lower jaw of hippopotamus; 3 crania of small mammalia (posterior portions); 2 crania of reptiles, one of which is a large crocodile's head; teeth of horse, pig, and ruminant; vertebræ of reptiles and small mammalia; and 10 fragments of other bones..... | Dr. A. H. Leith. |
| Fossil echinodermata, (8) specimens of, from Scinde. | ——— |
| ———palm-wood, (3 large specimens,) from Prome. | Dr. J. Welsh. |
| Fossils from the tertiary, lacustrine, and Oolitic (?) formations in the neighbourhood of Nagpur:—Tertiary and lacustrine—fragments, large and small, of endogenous and exogenous woods, seeds, and fruits, and also of freshwater shells from the former. Oolitic (?)—impressions (red-coloured) in white micaceous sandstone, of ferns and other plants, among which are *Glossopteris Browniana, G. angustifolia, Cyclopteris, Calamites, Vertebraria* (?) &c. &c.. ..... | Rev. S. Hislop. |
| ——— and geological specimens from some of the islands in the Persian Gulf..... | Lieut. C. G. Constable. |
| ——— and geological specimens from part of the Western Coast of Kattyawar..... | ——— |

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| Fossil shells from the tertiary formation on the Coast of Travancore ..... | Maj.Genl.Cullen. |
| Fossiliferous Limestone, specimens of, containing *Orbitolites*, from the NW. Coast of Kattywar ..... | Lieut. C. G. Constable. |
| Geological specimens, collection of, made by a party who visited the Mud Volcanoes near Hiñglaj, in the district of Luss, consisting of tertiary conglomerate, sandstone, and shells from the Hara Range; also specimens of consolidated and soft clay from parts of the mud effusions, together with pyrites, crystallized fibrous calc-spar, and a mixture of calcareous mud, sulphur, and gypsum ..... | [Esq. H. B. E. Frere, |
| Gold sandstone, specimens of the so-called, from Cutch, in the creeks along the coast..... | [Esq. A. D. Robertson, |
| ——— Ditto ditto ditto ditto.... | P.M.Dalzell,Esq. |
| Group of 75 Rhahans (Burman Monks), listening to their Superior expounding the Buddhist Scriptures, dug out of an old Pagoda in the fort of Bassein, July 1852..... | Dr. J. Welsh. |
| ——— of Figures in Relief, in white marble, from a Hindu temple in Guzerat..... | R. Willis, Esq. |
| Hornblende, green and idocrase (?) in granular calc-spar rock, from near Tinnevelly ..... | Maj.Genl.Cullen. |
| Impressions of stems of endogenous plants, and small mollusca, (*Cyrena ?* 2 species,) in red argillo-micaceous sandstone, also silicified dicotyledonous wood, from between 60 and 80 miles S. of Nagpur (4 specimens)..... | Rev. J. Hislop. |
| Iron Ore, possessing strong polarity, specimen of, from Kuneswar, 80 miles SE. of Nagpur.... | ——— |
| Laterite from a mass *in situ*, specimens of, on the highest point of Worlee hill, a few yards north of the flag-staff..... | H. J. Carter, Esq. |
| ——— pisiform, from Amarapur..... | Dr.W.H.Bradley. |
| Lichen geographicus, on petro silex, from the Great End Crag, Borrowdale, Cumberland .. | Dr. A. H. Leith. |
| Manganese Ore (Pyrolusite), specimen of, from the Sewajpoor hills SE. of Pownghur, and from | |

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| Jumboogaum; also specular iron ore, specimen of, from the Ghoor hills..... | Major G. Fulljames. |
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| Metallic and earthy minerals, (20) specimens of, illustrative of the economic geology of Southern India..... | A. Spens, Esq. |
| Micaceous, argillo-siliceous sandstone of various colours, (upwards of 30 specimens,) white, red, purple, brown, variegated; some bearing vegetable impressions; one portion of a fern (*Pecopteris*) from the neighbourhood (north) of Ellichpur; portions of the same formation indurated by heat..... | Dr. W. H. Bradley. |
| Monocotyledonous and dycotyledonous silicified woods, specimens of, beautifully cut and polished; also cut and polished silicified fossiliferous shale and shells from the lacustrine formation, in the neighbourhood of Saugor; fossil bones from the calcareous conglomerate of the upper part of the Nerbudda and its tributaries, among which is a transverse section of an elephant's tusk, friable, $7\frac{1}{2}$ inches in its widest diameter (solid); all from the neighbourhood of Saugor, in Central India..... | Captain W. T. Nicolls. |
| Ornamental architecture, (8) fragments of, and one terra cotta mould from the ruins of the Buddhist temple near Jerruck, on the Indus ..... | W. Cole, Esq. |
| *Ostrea hyotis*, specimen of, taken from the keel of one of the frigates of the Imam of Muscat. | Dr. G. Buist. |
| *Physa Prinsepii*, and *Unio Deccanensis*, free and imbedded specimens of, in semi-chertified | |

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portions of the lacustrine deposits from the neighbourhood of Ellichpur..... Dr. W. H. Bradley.

Remains taken from cairns at Andôla, Chikănhălli, Moul Ali, and Narkailpalli, alluded to, and figured in Captain Taylor's paper on cromlechs, cairns, &c. (vide Nos. XIV. and XVII. of the Society's Journal,) viz. of adult human bones, two copper bells, a copper chain ornament, spear-heads, arrow-heads, a tripod, spoon, pottery (7 large and 26 small vessels)..... Capt. M. Taylor.

Rock-specimens from granite, trap, and metamorphic and tertiary limestone in the Rewa Kanta..... Major G. Fulljames.

——— (95,) illustrative of the geology and mineral wealth of the Salt Range, in the Punjab; also of the Murree, Huzara, and Cashmere hills..... Supreme Govt.

——— consisting of granite, gneiss, mica, schiste, talc, diorite; metamorphic shales, limestone and sandstone; trap, basalt, and laterite, with a great number of the varieties of each; micaceous iron ore, copper ore, gold sand, and diamond breccia, all from the Southern Mahratta Country..... Lieut. A. Aytoun.

——— (24) specimens of building materials, useful and ornamental, from the Salt Range in the Punjab, squared and polished..... Bd. of Adm. of Lahore.

——— from the neighbourhood of Nagpur, consisting of saccharoid, crystalline, white dolomite, with and without red steatite; diorite, and vesicular basalt, the vesicles coated with a mineral like obsidian; freshwater shells, and portions of the bones of mammalia, from the pliocene deposits in the neighbourhood of the Nerbudda..... Rev. J. Hislop.

——— graphite in a highly crystalline white granular limestone from Tinnevelly..... Maj. Genl. Cullen.

Sandals, (a pair,) made of the leaves of the date-tree, worn by the tribes of Beyla..... [Esq. H. B. E. Frere,

Selenite, portion of, in the cavity of a geode lined

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| with laumonite and calcspar, from the trap of Bombay (rare).. ..... | Dr. G. Buist. |
| Scoriæ, specimens of, from the Loonar Crater..... | Dr.W.H.Bradley. |
| Sepulchral Urns, (3,) from a mound in the vicinity of Bagdad, excavated under the superintendence of W. H. Barker, Esq., I. N..... | [Esq. W. H. Barker, |
| Shells, (35) specimens of, in duplicate and triplicate, of 15 genera of land and freshwater, collected from the island of Bombay..... | Dr. A. H. Leith. |
| Stalactites of Salt, from a cavern in the island of Kishen, Persian Gulf.. ..... | Lieut. C. G. Constable. |
| Umbrella, (gilt,) used by the Burmese as an emblem of rank, and by the War Chiefs as a standard; taken at the capture of Bassein on the 19th May 1852.. ..... | Dr. J. Welsh. |
| Vegetable impressions from the coal strata near Newcastle, consisting of a large fragment of *Lepidodendron elegans*, (2 feet 3 inches long, and 11 inches broad,) and a long ensiform leaf, with parallel veins (1 foot 7 inches long, and 1½ inch broad)..... | Dr. A. H. Leith. |
| Water, specimens of, from the Aghor river, and different localities in the Mud Volcano district, in the province of Luss..... | [Esq. H. B. E. Frere, |
| Woods, fossil monocotyledonous and dycotyledonous, specimens of, found near the village of Narainpur, 18 miles SE. of Saugor..... | Captain W. T. Nicolls. |

## ORIGINAL COMMUNICATIONS.

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| Africa, Copy of a Map illustrative of the Travels of the Rev. D. Livingstone, and Mr. Oswell, Madras C. S., in the interior of Africa, NE. of the Colony of the Cape of Good Hope, embracing a Visit to the Great Lake Ngamee.—15*th September* 1853. (*a*).. ..... | [Esq. H. W. Reeves, |

(*a*) Recorded.

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| Barr (Capt. C. W.), Vocabulary of Slang Language used by the Mangs and Ramoosees of Kolapore. —*20th January* 1853. (*b*)..... | Govt. of Bombay. |
| Bradley (Dr. W. H.), A short Description of the Cave-Temples of Baitalbarree and Doulatabad, first brought to the notice of the Society by Captain Rose, with 30 Fac-similes of Inscriptions from these and other Cave-Temples. —*17th March* 1853. (*c*)..... | The Author. |
| Brahminabad, River of, extract (paragraphs 6 to 9) from a letter dated 28th February 1853, from the Acting Collector of Hydrabad, relative to, situated about 9 miles ESE. of Shadadpoor.— *21st April* 1853. (*d*)..... | [Esq. H. B. E. Frere, |
| Carter (H. J., Esq.), Description of *Orbitolites Malabarica* (new species), from the Tertiary Limestone of the Coast of Travancore, illustrative of the Spiral and not Concentric Arrangement of Chambers in D'Orbigny's order *Cyclostegues*.—*17th February* 1853. (*e*) .. | The Author. |
| ——— Summary of the Geology of India between the Ganges, the Indus, and Cape Comorin.— *18th August* 1853. (*f*) ..... | ——— |
| De Crespigny (Dr. E. N. C.), Short Descriptions of 23 Species of Freshwater Fishes from the Rivers in Guzerat, with a drawing of each.— *17th November* 1853. (*g*)..... | ——— |
| Edwards (T. E.), Report on a Survey of the River Taptee.—*16th December* 1852. (*h*)..... | Govt. of Bombay. |
| Framjee (D., Esq.), Comparison, and Re-examination, with Notes, of the Bilingual Inscriptions of Haj-i-Abad, near Nuksh-i-Rustam, published in Sir Ker Porter's Travels in Persia, and in Professor Westergaard's edition of the Zend-avesta.—*17th February and 20th Oct.* 1853. (*i*) | The Author. |
| Frere (H. B. E., Esq.), Account of the Remains of a Buddhist Building, 85½ feet square, discovered | |

(*b*) See Selection of Government Records, Part I. (*c*) p. 117.
(*d*) Deferred. (*e*) p. 142. (*f*) p. 179. (*g*) Recorded.
(*h*) See abstract of, Proceed. Off. Lit. &c. (*i*) See next No.

| | COMMUNICATED BY |
|---|---|
| by W. Cole, Esq., Deputy Collector of Kurrachee, in a Mound 3 miles below Jerruck, on the Indus, in Lower Scinde, with specimens of the Bricks and Ornamental Parts, which are all in terra cotta. Also copy of an Inscription some miles off.—19*th May* 1853. (*j*) | The Author. |
| Fulljames, (Maj. G.), A Description of the Salt-water Lake called the Null, situated on the Isthmus of Kattyawar (with a Topographical Sketch).—17*th March* 1853. (*k*) | ——— |
| Hislop (Rev. S. J.), Geology of the Nagpur State. —17*th March* 1853. (*l*) | ——— |
| Impey (E., Esq.), Description of the Caves of Koolvee, in Malwa (with Ground-plan and Drawing).—19*th May* 1853. (*m*) | Govt. of Bombay. |
| Kurrachee, letter enclosing one from Captain Preedy, with Sketch Map in Original, on the Remains of an Ancient People in the Collectorate of.—15*th September* 1853. (*n*) | [Esq. H. B. E. Frere, |
| Leith (Dr. A. H.), Note on an apparently undescribed Genus of *Gasteropod*.—17*th March* 1853. (*o*) | The Author. |
| Phillips (T., Esq.), Memorandum on the Ruins of Shakapur.—16*th June* 1853. (*p*) | ——— |
| Romer (J., Esq.), Brief Notices of Persian, and of the Language called Zend. By John Romer, Esq., M.R.A.S., formerly President of the Society.—20*th January* 1853. (*q*) | Rev. Dr. J. Wilson. |
| Stevenson (Rev. J., D.D.), On the Násik Inscriptions.—17*th February* 1853. (*r*) | The Author. |
| ——— Sahyádri Inscriptions.—20*th October* 1853. (*s*) | ——— |
| ——— on Buddhist Antiquities in China. 15*th September* 1853. (*t*) | ——— |
| ——— Tithyas or Tirthakas of the Buddhists and the Gymnosophists of the Greeks, Digambar Jains.—20*th October* 1853. (*u*) | ——— |

(*j*) p. 357. (*k*) p. 109. (*l*) p. 58. (*m*) p. 336. (*n*) p. 145.
(*o*) p. 145. (*p*) Recorded. (*q*) p. 95. (*r*) p. 35.
(*s*) p. 151. (*t*) See next No. (*u*) See next No.

| | COMMUNICATED BY |
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| Sunjana (P. D. B.), Translation of the Pehlivi Inscription at Haj-i-Abad, near Nuksh-i-Rustam, corrected from Professor Westergaard's copy in his lithographed edition of the Zendavesta.—17*th February* and 20*th October* 1853. (*v*) | The Author. |
| Translation of a Copper-plate Edict appointing a Fee to be paid from the Punchanum and other Tribes to one Gajankoosh Wuntpoolee, dated *Shalivahan Shaka* 1022 (A. D. 1100), found in the possession of a Gang of Dacoits in the Southern Mahratta Country.—17*th November* 1853. (*w*) | Govt. of Bombay. |
| Westergaard (Prof. N. L.), The Ancient Iranian Mythology; a Letter to the Rev. Dr. Wilson, Honorary President of the Society.—21*st April* 1853. (*x*) | Rev. Dr. J. Wilson. |

## PROCEEDINGS, OFFICIAL, LITERARY, AND SCIENTIFIC.

IT having been stated by the *Secretary* that His Excellency the Commander in Chief, Lord Frederick Fitzclarence, wished to become a Member of the Society, the Rev. Dr. Wilson, *Honorary President*, seconded by the Rev. P. Anderson, proposed that a deputation, consisting of the *President*, A. Malet, Esq., *Vice-President*, and the *Secretary*, should wait upon his Lordship at the earliest opportunity, for the purpose of soliciting him to become *Vice-Patron* of the Society.

Captain T. Barr's letter intimates his intention to furnish the Society with a vocabulary of the dialect spoken by the Mangs of Kolapore, to accompany his sketch of the manners and customs of this people, read at the last meeting of the Society.

In Captain Nicolls' letter is contained a short account of the specimens of silicified monocotyledonous and dycotyledonous wood, &c. mentioned (p. 371). These specimens, which are beautifully cut and polished, form a valuable addition to others already forwarded from the

(*v*) See next No. (*w*) Recorded. (*x*) p. 77.

same neighbourhood, and partly by the same officer. Captain Nicolls states that they were found strewed on the surface of the black (regur) soil near the village of Narrainpoor, associated with similar sized pieces of chert, and occasionally jasper and radiated zeolite. The fossilized bone, which is a phalanx of some large animal, was obtained from the same locality.

The survey of the river Taptee by T. E. Edwards, Esq., extends over 232 miles of the river Taptee, viz. from the Wanjore branch, on the road between Malligaum and Boorhanpoor, to Surat. The width of the river, until emerging from the Daung jungles into Guzerat, is from 800 to 1,200 feet; afterwards it is from 1,500 to 3,000 feet wide; that over the gravelly shoals is from 1,500 to 1,300 feet wide, and the depth of the water from 1 foot 6 inches to 2 feet 9 inches, with a stream running from 2 to 3 miles per hour. The banks in Khandeish are about 60 feet high, of which the upper part consists of black, and the lower of yellow earth. Where the spurs of the Satpoora hills and the tail of the Western Ghauts come upon the river, the banks are 150 and 200 feet high. The bed of the river is gravelly the whole way. On emerging from the Daung jungles into Guzerat, the banks are low. Mr. Edwards proposes to deepen the water over the shoals by narrowing the channel; and after removing a few rocky obstructions in other parts, to navigate the river with flat boats of a particular kind, which he describes, and which might be tracked the whole way. He then considers "that a great portion of the trade of Berar, (Oomrawutty being only 130 miles distant,) the trade from Bundelkhund passing through Hoshungabad, and the whole of the traffic from Lahore along the Agra road, would be diverged down the Taptee to Surat"; and not improbable, but that at some future period it might be found advantageous to send coals from the coalfields near Hoshungabad by the same course.—16*th December* 1852.

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With reference to the deputation appointed at the last meeting to wait on the Right Honorable Lord Frederick Fitzclarence, Commander-in-Chief, &c. &c. to solicit his Lordship to become *Vice-Patron* of the Society, the *Secretary* reported that his Lordship had expressed himself much pleased to comply with the Society's request, but would have prefered a *Vice-Presidentship*, that he might have had an opportunity of being more useful. The Society regretted that there was not a vacancy among the *Vice-Presidents*, to take advantage of his Lordship's kind consideration.

The Government circular No. 124 of 1853 intimates that the Council

of the Society of Arts have resolved on embodying their proposed exhibition of the products and manufactures of India with a great International Exhibition to be held in Dublin this year, and requests the Society to give the same publicity to this as it did to the original intention. The *Secretary* was directed to act accordingly.

Dr. Fleming's letter No. 89, dated 9th December last, states, that in compliance with the request from the Secretary to Government with the Governor General, in his letter No. 77, dated 17th March 1851, and which was made known to the Society through Sir H. M. Elliot about the same time, he has prepared for the Society's museum "a collection of specimens illustrative of the geology and mineral wealth of the Salt Range in the Punjaub," also "a collection of rocks, &c. from the Murree, Huzara, and Cashmere hills." These had been carefully packed in a strong box, and forwarded from Jhelum on the 28th October last, to the care of the Secretary of the Board of Administration at Lahore, from whence Dr. Fleming had received advice of its despatch to Bombay, *viâ* Mooltan and Kurrachee. The letter is accompanied by a descriptive catalogue of the specimens, which bears evidence of their forming a most interesting and valuable contribution to the Society's museum.

A large roll of impressions of the inscriptions in the caves at Junir, with a plan of the latter by Lieutenant Brett, was laid on the table; also a letter from Mr. Brett, stating that he was now at Karli, taking impressions of the inscriptions in the caves of that place. The Rev. Dr. Wilson stated that the time sanctioned by the Supreme Government, viz. one year, for Mr. Brett to take these impressions, had nearly expired, and that although Mr. Brett had laboured very diligently during the whole of that time, yet as many, if not more, inscriptions remained to be taken, he therefore submitted to the Society the desirableness of getting Mr. Brett's appointment prolonged. The Cave-Temple Commission were requested to communicate their views on the subject to Government direct.

Accounts had been received from Mr. Fallon at Karli, stating that he was progressing rapidly with his illustrations of the caves at that place.

The Rev. Dr. Wilson, seconded by Thomas L. Jenkins, Esq., proposed, that as the overland carriage had been so much reduced, the subject of having the Society's supplies forwarded by this route instead of round the Cape be submitted for the consideration of the Committee, and brought forward for discussion at the next meeting. This was unanimously agreed to.

Dr. Wilson, in directing attention to the paper entitled "Brief Notices of Persian, and the Language called Zend," which had been forwarded to him for presentation to the Society by Mr. Romer, formerly *President* of the Society, remarked, that the languages connected with Iran, genuine and spurious, to which attention of late years had been directed, are the Zend, in which the books esteemed sacred by the Parsis are found, and which by some, though not by our best British linguists, had long been held to be the parent of the modern Persian; the language in which the Achæmenian inscriptions at Besitun and other places are composed, which is now denominated by German philologists the old Persian, and of which the Zend is undoubtedly not the parent, though it is in some respects cognate; the Sasanidan, in which the inscription at Haj-i-Abad, which would presently form the subject of conversation, and some similar inscriptions of the dynasty of Sasan, translated by the Baron de Sacy, are specimens; the Pehlivi, in which translations of the Zend writings, and a few other works are found in the hands of the Parsis, which is held by Westergaard to be only a dialectine form of the Persian, misread by the Parsis in consequence of the use of an imperfect and ambiguous alphabet, and which is denominated by Spiegel the "Parsi," and said by him to be intermediate between the language of the Sasanidan inscriptions and that of the Shah-Nameh of Firdausi; the Asmani Zaban of the Desatir, now admitted by all to be a fabrication; and the Persian, properly so called, in which all the works of Iran since the days of Firdausi appear. Respecting the last mentioned language, Mr. Romer maintains that its connections with the other languages, with the exception of the so-called Pehlivi, which appears substantially identical with it, notwithstanding the assertion of certain of the Parsis to the contrary, are exceedingly remote and insignificant, and by no means of the character long alleged by the able and zealous orientalists of the continent. The claims to genuineness urged in behalf of the Zend he disputes, as resting on insufficient grounds, particularly as no vestiges of it as a language ever spoken can be found: its historical connections cannot be traced; its structure and form are entirely diverse from the Persian, especially in its having inflexions, while the Persian has none; its literature is frivolous and absurd in its character, and its undoubted relations to the Sanskrit are artificial and suspicious. He calls upon Dr. Wilson to "undertake the task of a careful re-examination of the points which have satisfied him as to the genuineness of the Zend," particularly as he has renounced all faith in the authenticity of the Pehlivi as a distinct language, by giving in his adherence to the views of Westergaard. Dr. Wilson stated, that

though his views of the Zend remained unchanged, and are founded, not only on the analogies which it bears to most of the languages of the Indo-Germanic family, both near and remote, on various though brief geographical and historical allusions which it contains, and on certain analogies, and at the same time antagonisms, to the oldest forms of Hinduism which it expresses, yet the request of one so much venerated in Bombay as Mr. Romer, and who conducts his discussions with a happy union of spirit and courtesy, was received by him with the greatest respect. He concluded by moving, that the Society express the high gratification with which they have received Mr. Romer's communication, and resolve to insert it in the Journal of the Society.

Dr. Wilson's motion having been seconded by A. Malet, Esq., *Vice-President*, was unanimously adopted.

A letter was read from Manockjee Cursetjee, Esq., who had been requested at last Meeting to communicate his views regarding the decipherment and translation, by the Parsi Dastur, Pestonjee Behramji, of a rock inscription in what is called the Pehlivi language, found at Haj-i-Abad, near Nuksh-i-Rustam, which is understood to refer to Sapor the son of Ardeshir (Artaxerxes, the restorer of the Persian monarchy in the 3rd century). An animated conversation took place as to the value of the Dastur's labours. As no authoritative translation of the important inscription in question exists,—Mr. E. Thomas (Jl. As. Soc. vol. xii. page 263) expressly states that no translation whatever has been made,—the Society requested that the Gujarati version forwarded by the Dastur through Mr. Green should be rendered into English, and submitted to the Society. A letter from Mr. Dhunjibhoy Framji was also read, in which he stated that upwards of two years ago he had deciphered and translated the same important inscription, arriving, however, at considerably different results from those of the Dastur's labours. The *Secretary* was requested to communicate with Mr. Dhunjibhoy Framji (who was not present), and obtain a copy of his translation, and the remarks which he stated himself prepared to make on the paper of Mr. Pestonji Behramji, in the hope that the communications of both these gentlemen on this difficult ancient record might ultimately be inserted in the journal of the Society.

Mr. Green also stated that the same Dastur was preparing a critique on Professor Spiegel's version of the 19th Fargard of the Vendidad, as given in Mr. Mitchell's paper in the last number of the Journal. The Society expressed its readiness to receive the communication.

The *Secretary* stated, with reference to the specimen of laterite

mentioned, (p. 370,) that he had broken it off from a mass *in situ* on the highest point of Worlee hill, a few yards north of the flag-staff. That the mass reposed on the basaltic rock there, and that it was decomposing into red earth, just the same as that of the basalt, only of a deeper colour, from the greater abundance of iron in its composition. There was no question of its not being genuine laterite, and all could see that it was identical with the specimens of laterite from the Southern Mahratta Country which lay on the table. It was composed, just as these were, of a mass of iron clay, permeated with sinuous cavities, presenting a smooth polished surface internally, and empty, or filled with a greasy whitish yellow earth—while here and there in the general mass were spots of blue iron ore common to this rock. It could not be confounded with the rolled pieces of laterite found about the declivities and shores of the island of Bombay, which may or may not have come from similar sources, because on the top of Worlee hill it was to be found not only *en masse*, but *in situ* reposing on the basalt, just as it does elsewhere. The portion of rock would be deposited among the other specimens illustrative of the geology of the island of Bombay, and might be compared by any one with the specimens of laterite from the Southern Mahratta Country, in the glass-case immediately opposite.—*20th January* 1853.

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The Government letter No. 440 of 1853, accompanied by the box of specimens above mentioned, from Dr. Fleming, encloses also a copy of a letter, No. 1783 of 1852, from P. Melvill, Esq., Secretary to the Board of Administration of Lahore, announcing the despatch of the same from Mooltan to Bombay, *vid* Kurrachee.

This valuable collection, which had arrived safely, and had been laid on the table, was ordered to be put in a convenient place in the museum, and the *Secretary* requested to acknowledge its receipt, with the most grateful thanks of the Society to the Supreme Government, through the Government of Bombay; also to transmit the best thanks of the Society to Dr. Fleming, for the care and trouble he had taken in the preparation and packing of this handsome and instructive present.

Lieutenant Brett's letters, dated 23rd ultimo, and the 14th and 15th instants, forwarding respectively "Fac-similes of the Inscriptions in the Cave-Temples of Karli," a memorandum of contingent expenses during the time that he has been thus employed; and a request that the application for the extension of his appointment might be withdrawn, were submitted for the consideration and reply of the Cave-Temple Committee.

The copper coins above mentioned, forwarded by Captain Nicolls, were handed over for the examination of the *President*.

The Rev. Dr. Stevenson, in his paper mentioned, (p. 375,) stated that he had found four dates in the Násik caves, and two of them repeated in the Karli caves. Most of them were both in words and figures of the ancient type given by Prinsep. (Jl. As. Soc. vol. vii. pl. xx.) The dates are given in years, seasons, fortnights, and days, but no months. The numbers of the years range from 7 to 24, which made the *President* at first think that the dates were merely the number of the years of the reign of the monarch who caused the inscription to be executed. He found afterwards, however, that a Dukhunee prince, Gotamiputra, was celebrated as the reigning king, while the date was in the year of a Gujarat sovereign named Padma. This is the name of the son of the monarch who is supposed to have instituted the Balabhi era, and the father's name, which on the inscription is Vasava, by the aid of Ferishta, the Aqueen Akbaree, and a Hindu work called the Vikrama Upakhyana, quoted by Wildford, he identified with the Sridhara of Wathen's Gujarat copper-plate inscriptions. The caves, then, that bear these dated inscriptions, were all executed between A. D. 326 and 343.

The translations of the Pehlivi inscriptions at Haj-i-Abad, with the observations of the translators, Messrs. Dhunjibhoy Framji, and Pestonji Dastur, which accompanied them, were delivered to Professor Harkness, for examination and report at the next meeting.—*17th February* 1853.

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In reply to the letters from the Managers of the Royal Institution of London, forwarding the notices and report mentioned, (p. 364,) and requesting that copies of the Society's Journal might be presented to the library of the Institution, the *Secretary* was directed to acknowledge the receipt of the letter, &c. and to forward by the first opportunity a complete set of the Society's Journal,—could a copy of each of the numbers be spared.

To the Royal Geographical Society, the *Secretary* was also directed to send the numbers of the Journal applied for, viz. i. and ii. of vol. i., and x. of vol. ii.

Professor Harkness' report on the Pehlivi inscriptions deciphered and translated by Messrs. Dhunjibhoy Framji and Pestonji Behramji having been read, it was resolved that the transcripts and English translations of both should be printed in the next number of the Society's Journal.

The following letter and its accompaniment were received from H. B. E. Frere, Esq., C. S., Commissioner in Scinde:—

Sir,—I have the honour to enclose the accompanying translation, with which Mr. H. B. Ellis has favoured me, of a letter which has caused some stir among the Mahomedan population of this province, as it may be of interest to the Society.

2. For some years past there has been great mortality, especially from cholera, among the pilgrims at Mecca; it was said that the cause of this had been revealed by the Prophet in a vision to one of his faithful disciples at Mecca. The Prophet attributed the plague to the evil lives of his disciples, and directed general promulgation of an exhortation to repentance and reformation of manners. This led to the issue of the letter now forwarded, which was brought to Scinde some months ago, and has been everywhere received with respectful attention.

3. I have received more than one formal application, consequent, I believe, on the receipt of this letter, to permit the ancient rigour of the Mahomedan law to be enforced, not only against all kinds of immorality, but against infractions of the ceremonial law, neglect of prayers, and breaches of fasts. One petitioner offered, if Hindoos and non-conformists were taxed according to ancient custom, to perform the right to levy the tax for four lakhs of rupees.

*28th February* 1853. (Signed) H. B. E. Frere.

Firman.

In the name of God, who is gracious and merciful!

God be praised, who is the Creator of all the creatures, and of the world to come for religious people; he is an enemy to none but to tyrants, and may the mercy of God and peace be on our Lord Mahomed, and upon his descendants! Now this is the revelation from the Prophet (upon whom be the mercy of God!). Sheikh Humza, the servant of the Tomb of the Prophet, says, that one night while I was asleep, I was (in a dream) reading a chapter from the Koran, when I saw the Prophet, who told me to acquaint him with the circumstances of his sect. In reply I said:—"Prophet of the Lord! Do you inform me thereof." The Prophet then said that a hundred thousand of them are dead, and not one of them but was a sinner and liar: truly they were false accusers, and bearers of false witness, nor had they any mercy among them, great or small; and in truth their faces were black; and they had been wholly engaged in the affairs of the world, and with their

children, women, and property, and had not the slightest fear of chastisement in the grave; they amused themselves with conversation while the Koran was being read, and listened not to it; they conversed much in the mosques, and did not pay proper attention in saying their prayers, but were thinking at the same time of the world and its vain wealth, and of deeds of infidelity. The Almighty Lord said to him :—"Mahomed, look to the people of your sect: they are indeed on the wrong way, and I desire to change their appearance." He (the Prophet) then begged that time might be granted him until he could give them an injunction, and inform them of his (the Lord's) anger, and if they did not attend to it, the Lord should then carry out his intentions. The Prophet then said :—"Sheikh Humza! were the people to abstain from drinking wine, from murdering, from appropriating forcibly the property of orphans, backing theft, abuse of virtuous women, and from all that is forbidden by God; warn them to visit Mecca, be attentive to prayers, and give alms. Verily, upon them will come the day of judgment, which is near at hand, and the gates of repentance will shortly be shut: enjoin them to follow the right path, and abstain from evil deeds, and order them to repent; for in this year there will truly be a very great plague, and men will be neglectful of it. This is a revelation to put them on their guard, and at last I will solicit the Lord on their behalf. Tell them they must keep fasts for six days, and on the seventh give alms according to their ability, and then, in truth, God will assuage his wrath with them." When I awoke I saw this written in red colours on the palm of my right hand. And it was written at the close, that if any one fail to say his prayers, you should not communicate with him, nor visit him when he is ill, nor attend his funeral when he is dead; and it was written therein, that whoever promulgated this notice from city to city, and from place to place, for him I will make solicitation, and whoever, on reading the notice, fails to promulgate it, his face the Lord will make black in the day of judgment. I swear that I have not added a word in this letter, and I now set off to visit every city, and promulgate this abroad. Do you strive also, and hope for grace through Mahomed the Prophet of God. O God! do not turn us to be proud or ungrateful, nor make us as those who prefer the world to their faith. O God! cause us to repent of our sins before death, be merciful to us when dying, and do not punish us after death. O Lord! confirm us in the faith of Mussulmans, and join us with good men. Amen and Amen.

The bearer of this Firman is Syed Abdoolla Khoorshan Hoosainee, who left Medina in Shaban 1268. Copied by Abdoorahman at Mehur.

True translation (Signed) H. B. Ellis, Assistant Commissioner.—17*th March* 1853.

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The letter from the Geographical Society, dated 12th instant, in reply to the Society's, dated 17th ultimo, offering a place in the library to the globes which form part of the "Ross Testimonial," if the Society considered their usefulness would be thereby extended, states that the Geographical Society will be happy to take advantage of this offer, and intimates that instructions have already been issued for transferring the globes to their new destination.

The Geographical Society's letter, dated 9th instant, mentioning that a large collection of philosophical instruments had been received, and requesting a place for the exhibition of the barometers in the Society's library for a few weeks, had been considered by the Committee of Management, who had offered, in reply, any unoccupied part in the library for the purpose mentioned.

No. XVII. of the Society's Journal was placed on the table.

Dr. Wilson, in laying Professor Westergaard's learned paper on the Arian Mythology before the Society, proposed that, as it is more suitable for the studious perusal of the orientalist than for a hasty reading at a hurried meeting, it should be inserted in the next number of the Society's Journal. It notices the coincidence, and at the same time discrepance, of several of the Zendic with the Vedic legends ; endeavours to trace their origin to traditions of a primitive era of physical and moral bliss, and to aspirations for a renewal of happiness both in the present and future life ; and points out their subsequent corruption in the interpretation of them as historical notices of kings, heroes, and prophetical personages. The oldest of these legends affords an insight into the ante-historical time, when the Japhetic nations of Iran and India began to develope their religious and social existence, putting their own interpretations on the phenomena of nature and the wants of the human soul. The more modern of them, though still very ancient, mark a growing estrangement from one another of the two branches of the Arian nation, the Indian and Persian. The discussion of them in a calm philosophical spirit, with a remarkable knowledge of the documents in which they are embodied, and of the discussions of which they have given rise, both in Europe and the East, constitutes a claim to attention in behalf of Mr. Westergaard which all will willingly accord.

The *President*, having expressed the gratitude of the meeting for this peculiarly valuable communication, seconded the proposal for its publication, which was unanimously agreed to.

The ruins of Brahminabad, in Mr. Frere's communication mentioned, (p. 374,) are stated to extend over an area of many miles, and the dry bed of a river to be close to them, which was probably a branch of the Lohana or Pooran, when it was running. Several hardly contested fields are stated to have been fought there between the armies of the Caliphs and Hindu Governors, and mounds are still pointed out as covering the remains of the slain. The ruins of the old city are said to be well worth visiting, chiefly from their being among the few remains of antiquity that exist in the neighbourhood of Shahdadpoor.

The plans of the vihara cave called Guttoor Duz, in the Circar of Baitalbaree, and of that in the Pipal Khora, Circar of Dowlatabad; with a sketch of the sphynx figures *in situ* in the latter, by Dr. Bradley, alluded to in his descriptions of the excavations read at last meeting, were laid on the table.

Mr. Fallon's oil-painting of the interior of the great chaitya cave at Karli, with sketches of the head-dresses of some of the figures there, were laid before the meeting, and much admired.

The *Secretary* requested the attention of the meeting to a learned paper, with sketches, by E. C. Bayley, Esq., of the Bengal Civil Service, in the last No. (VII.) of the Journal of the Bengal Asiatic Society, on sculptures found in the district of Peshawur, similar to those which Dr. Arnott and Captain Shaw had presented to the Society from the same neighbourhood, in all 45 pieces. The ruined temple from which these appear to have come is called Jamal Giri, and is situated on a hill about 30 miles from Peshawur, by the road into the Eusofzye country from the Swat valley. The author considers them to be of Buddhist origin, though this fact is not so self-evident as their indebtedness to Greek art. He concludes "that the earliest *possible* period to which these figures can be assigned is 287 B. C., and the latest 200 B. C., while there is every probability that the age of their execution was between 271 and 225 B. C., a period of only 46 years." Other ruins of the same kind had been seen in the same neighbourhood, from which it was hoped that still more satisfactory information might be obtained respecting their history.

Dr. Buist then explained, in a most interesting and instructive manner, the nature and comparative advantages of several kinds of portable barometers, in which the superiority of those lately received by the Geographical Society was made very evident. He also mentioned the advantages and disadvantages of the aneroid and sympiesometer, several of which were laid on the table; and then drew the attention of the meeting to the working of a pluviometer, and the means of

correctly ascertaining the amount of evaporation during a given period with the same instrument; adverting, in conclusion, to the unsatisfactory data afforded by the wet-bulb hygrometers.—21*st April* 1853.

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The *Secretary* stated, that on account of the first number of the Society's Journal being out of print, it was impossible now to supply, either as presents or on purchase, a whole set to any one who applied for it, or to any one to whom the Society, out of respect, or return for favours, might wish to present a complete copy. Mr. Firth, the Superintendent of the Education Society's Press, had made an estimate for reprinting this number, which for 200 copies would amount to Rs. 137, without colouring the plates. It was resolved that Mr. Firth's terms should be accepted, and the number reprinted.

T. L. Jenkins, Esquire, seconded by the Rev. Dr. Wilson, proposed, that as the Society had not determined on having its books sent out overland by the Peninsular and Oriental Company's steamers, the subject of getting a certain number of them sent through the Post Office be referred to the Committee of Management for consideration as a more preferable arrangement.

The following is an abstract of a letter from Dr. Thom, H. M. S., to Dr. Buist, which accompanied the specimens of polarized basalt mentioned, (p. 367,) from the Mauritius:—"By the Captain of the *Shah Allum* I send you a piece of basaltic rock from the peak called the Pouce, which possesses a high degree of polarity, as you perceive when you bring it near to a magnetic needle. My attention was called to this by a vague account of the compass being disturbed at the summit of the Pouce, and I determined to ascertain the real nature of the disturbing cause, which seemed, by the extraordinary reports which I first read, to point to something of an electro-magnetic current. After two ascents to the peak in question, which is about 2,500 feet high, rising directly behind the town of Port Louis, and terminating in a point barely accessible, and not more than eight or ten feet at the summit, I was enabled to get some definite idea of the phenomena in question.

"The whole of the basaltic mass of rock which forms the highest part of the peak is charged with magnetic fluid, whether forming a part of the central mass, on jutting angles, or in detached and broken bits; and whether with the surface corroded and disintegrated, or with the compact, crystalline, grey fracture of the interior when exposed by breaking off a corner.

"Our artificial magnets were completely reversed, and the poles alternately turned to every point of the horizon, according to the

relative position between the currents of the local poles of the rocks. Without removing a step from a particular spot, by carrying in the hand a surveying compass quickly round any of the jutting points of rock, it acquired a circular motion, which lasted for nearly a minute. The magnetic force is most powerfully developed at the *projecting* and *highest* points of the peak, and decreasing in intensity downwards, so that one hundred feet below the summit all traces of local influence on the compass disappear, yet the whole of the peak, and the mountain from which it shoots up, is one, and apparently similar mass of trap basalt.

"But the most curious fact is, that not only the summit of the Pouce, but every other peak of the serrated edges of the mountain near Port Louis, which have been examined, are found to possess an amount of resident magnetism which overpowers the artificial magnet. Yet the same inclined stratum of basalt, which possesses so high a degree of polarity when terminating in a point, and projecting into the clouds, is without any influence of this nature, as it sinks down to form the sides of the valley, table-land, and plain of the island, while every peak that has yet been tried shows a local magnetic force. Neither I nor any one else has yet seen any sign of this in the sides of the mountain, or rocky masses of the plain. The only pieces of magnetic stone found below the summit of the mountain have all the appearance of rolled stones, which have come down from the heights above.

"The investigation of all the facts nicely, to warrant us in arriving at any right conclusion on this curious question, will be a very slow process, but I have got the Government Surveyor now in the act of surveying Government ground to note down, at all points, where there may chance to be any sign of local magnetism which he may observe. With the cold weather, and a little less office work, I too shall visit as many of the other peaks of the island as possible, and in another year be able to reduce all our observations to order. As yet Mr. Corley, the Surveyor, says that every peak is magnetic, but he has not found any rocks in the valley so; what further observation may show, it is now to say.

"As far as the facts go, they are suggestive of many new views on the subject of local magnetism, especially when we recollect that the whole island is little more than a terrestrial galvanic battery, surrounded by the ocean, and annually subject to give to, and receive from the clouds, intense charges of electric fluid at particular seasons through these magnetised peaks.

" As the mountains of the Deccan and Western Ghauts of India exactly resemble those of Mauritius in geological formation, aspect, &c. and those of Mahabuleshwur contain far more iron than either our Pouce or other ridges, it would be a curious inquiry to ascertain whether any phenomena such as I have noticed at the Mauritius may not also be found among the sharp peaks of the former. I hope you will get some of the many scientific persons who visit the hills to examine this question.

" The large piece of rock which I send to you was broken off the very highest point of the Pouce, and its natural structure is nearly that of the whole stratum as it dips down to Port Louis. The second specimen is partially disintegrated on the surface, but it was in a cleft within a foot of the summit."

Captain Meadows Taylor states, in his letter accompanying the piece of limestone with excavations in it mentioned, (p. 367,) as follows :—

" The great part of the Shorapore district is a limestone formation, I think identical with that of Kurnool, which Captain Newbold wrote upon. The best portions of it are of a fine hard grain, and of an iron-grey colour, and are very similar to lithographic stones indeed. I sent a good many slates to Captain Wingate, and some to Dr. Buist, for the purpose of being used in lithography, and believe they answered to a certain extent. The stone varies in hardness and in colour, the hardest peaks breaking with a conchoidal fracture, the softest and most argillaceous with a direct one. The colours are from dark-bluish grey, nearly black, to light yellowish and pinkish grey. Wherever the formation has not been disturbed by the granite, it is perfectly horizontal, lying in laminæ of from two feet to two inches in thickness, some being even thin enough to serve for slates, for which purpose they are made use of in the country villages.

" Now the upper strata of this formation is everywhere pierced by small holes, such as you see in the specimen I send you.

" These holes are nowhere found in the lower strata or laminæ of the formation. I have examined many places in the Bheema, where the rock is bare, and other places where the stone has been quarried for building, but can only find the perforations on the surface : perhaps they are more remarkable in the fields, where the surface-rock protrudes from the soil, or where the soil may be cleared away in a field with a shallow covering of earth over the rock. It will be found having the same kind of perforations nearly everywhere.

" I have never been able to find any fossil remains in the district, though I have searched very diligently for them.

"Some of the hardest of the limestone rests upon soft argillaceous shale, very friable, and of all colours from whitish-grey to yellow, pink, red, bluish, &c. greys, generally, (indeed invariably, where there is no disturbing cause at hand,) horizontal, agreeing with the limestone strata above.

"The specimen I send you is of the darker limestone, but whether in that or the lighter kind I sent to Dr. Buist, the perforations are exactly of the same shape and character, some longer and some smaller than others.

"In many parts near granite the limestone has been disturbed by the granite eruptions, and blocks are found as it were on their sides, and at various angles, having the perforations on the side uppermost, that is not perpendicular to the grain of the stone, as they would be if the stone had lain horizontally, but with the grain not on the surface, but on the side which is uppermost. It is evident from this that the perforations took place after the granitic disturbance.

"This limestone is identical with that of Kurnool, &c. and part of a very extensive formation in the Deccan. Here it is very interesting to see how the granite has thrown it about in some places, and actually raised up large masses of it, showing that it must have been older than many of the granite hills about. We have it, too, overlaid by a wave of trap-mud from the westward, which has reached as far as the edges of the limestone hills."

Of the two Hindu copper coins mentioned in the minutes of the Society's meeting held on the 17th February last, submitted to Dr. Stevenson for examination, Dr. Stevenson states that "they belong to the second Canauj series, described by Mr. Prinsep in the 4th volume of the Bengal Asiatic Journal, although not among the number therein mentioned. As far as I can make out from the broken state of some of the letters, the legend is *Srimad Lakshman Raja*."

The silver coin from the ruins of the town of Shakapur, which accompanied Mr. Frere's letter, was submitted to the Rev. Dr. Wilson for examination. Mr. Frere states in this letter, that he has requested Lieut. Phillips, who found this coin, to forward an account of Shakapur, copy of which, when received, will be sent to the Society. —19*th May* 1853.

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The letter No. 143, dated Pind Dadun Khan, 17th ultimo, from W. Purdon, Esq., announces the despatch, *viâ* Moultan, per coolies, of a box containing specimens of useful and ornamental building material, obtained from the Salt Range, and forwarded to the Society under

instructions from the Board of Administration for the affairs of the Punjab at Lahore. The letter enclosed a descriptive catalogue of the specimens.

Professor Lassen's letter, dated Bonn, 5th August last, acknowledges with thanks the receipt of Nos. XII., XIV., and XV. of the Society's Journal, and applies for No. XIII. This number to be forwarded by the earliest opportunity.

Of the Canarese inscriptions presented by Messrs. Reeves and Manson, C. S., to the Society, submitted to the Rev. G. H. Weigle for translation, and now returned with his note dated Dharwar, 29th April last, Mr. Weigle states as follows:—

"The inscription was put into my hands about a year ago, and I did my best to decipher it, but found it impossible. The first line is easy to read, and contains a well known distich. Having got thus far (before the inscription was presented to the Asiatic Society), I thought it would be easy to make out the rest, but I regret to say I found it far otherwise: neither I, nor any of the numerous Natives whom I consulted, could make out more than a few letters here and there. I sent the inscription to Mangalore, where it was examined by the Rev. H. Moegling and by his Moonshees, who, I am convinced, are the most learned Canarese men to be found at the present day, but the result was the same.

"It therefore seems that the copy is not an exact fac-simile of the inscription, which supposition is confirmed by the evident inequality of the letters and lines."

The ruins of the city of Shakapur, in Scinde, anciently called Mehmetpoor, Mr. Phillips states to be situated in the southern part of the Shah Bunder district, about ten miles south-east of Meerpoor Buttora, the chief town of the zillah.

At present there are only 50 houses there, situated on a large watercourse called the old Goongra, where the ruins may be traced for three miles in extent. These consist chiefly of mounds of burnt bricks of different sizes. The largest is situated close to the existing village, and is about 300 yards in circumference. This has not been opened. There is also a small burying ground, in which there are tombs of carved sandstone slabs, but without inscriptions.

A silver coin has been found, which was submitted to the Society by Mr. Frere at the last meeting, and some fragments of opaque blue glass, cornelian and agate which accompanied this paper: several copper coins have been found, but so corroded that the inscriptions are effaced.

The traditional history of Shakapur is, that the present village was named after the famous Cutch Saint "Shahputti," who travelled in that direction about 200 years since; that Mehmetpoor was founded by Mahomed Pysen Soomra, the first of that tribe, who reigned in Lower Scinde (14th or early part of the 15th century), when the present dry watercourse was the bed of the Indus. The next Chief named is Umeer Soomra, by which title the large mound of ruins mentioned also goes, as this is stated to be the remains of his palace. This Chief left two sons, Chumeesa and Doda. Doda, the younger, usurped the throne, and Chumeesa having laid a complaint before the then reigning Emperor at Delhi, Allahodeen, the latter sent a force back with him to recover his property, which Doda met at a place called Keree, 10 miles from Mehmetpoor. Here a battle ensued, in which both the brothers were slain and the Soomra army defeated; after which the Delhi force plundered Mehmetpoor, and set it on fire.—16*th June* 1853.

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The letter from Dr. Bowring, dated Athenæum, 1st ultimo, intimates the desire of the Governor General of Nertherlands India, that the Bombay Asiatic Society should interchange publications with the Batavian Society of Arts and Sciences in Java. Dr. Bowring also adds, that on any subject within the field of Chinese inquiry he will greatly rejoice in an opportunity of being useful to the Society.

It was resolved that a copy of the Society's Journal should be forwarded for the acceptance of the Batavian Society by the earliest opportunity.

The letter from A. Grote, Esq., dated 5th instant, intimates that the Council of the Asiatic Society of Bengal had cancelled all pecuniary obligations under which the Bombay Society laboured for this publication, intending henceforth to present them in exchange for those which they at present receive from the Society of Bombay.

The *Secretary* was directed to acknowledge the receipt of this letter with best thanks of the Society.—18*th August* 1853.

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With reference to the Government letter No. 2718, dated 17th ultimo, forwarding printed copies of a despatch No. 30, dated 24th May last, together with other correspondence, from the Honorable the Court of Directors, respecting an Universal Exhibition of Agricultural and Industrial Products to be held by the Emperor of the French at Paris in May 1855, and requesting the Society to give the greatest possible publicity to this announcement, the Secretary was directed to

adopt the best measures in the Society's power for carrying the Government request into effect.

The Rev. Dr. Stevenson's paper contained a translation, with notes, of a Buddhist inscription published in "*Fortune's Tea Districts of India and China*" page 324, in which he showed that the foreign characters there given are Tibetan letters; that the inscription contains three Buddhist sacred formularies, the middle one the famous *Om Mani Padme Humh*. Dr. Stevenson gave reasons for believing that these formulæ had been borrowed from India; that they were originally Tantrical, and afterwards adopted to Buddhism; and that they were respectively invocations to the Deity as first the Creator, now the Preserver, and finally about to be the Destroyer of the Universe.

With reference to the copies of the Haj-i-Abad inscription mentioned, (p. 374,) the author, Dhunjibhoy Framji, Esq., states that after having carefully re-examined them, he thinks that the copy which appears in Professor Westergaard's edition of the Bundhesh has been most carefully taken from the original, and that it is only inaccurate in a few characters; that the Sassanian lapidary Pehlivi inscription in Sir Ker Porter's Travels is also in some respects incorrect, and the Parthian or most ancient Pehlivi inscription appears to be still more so, which may have arisen from the difficulty with which it was obtained, for Sir Ker Porter states—"I copied them with all the accuracy in my power, being much impeded by the height and darkness of their position. One portion of the three upper lines I could not make out in the least." Between Sir Ker Porter's and Professor Westergaard's Pehlivi inscription, the author had discovered about thirty characters which differed from each other in their respective words; but as amongst these there were a few homogeneous ones, the difference in the decipherings was of no great consequence.

When Mr. Dhunjibhoy Framji first deciphered and translated this inscription from Sir Ker Porter's copy, he entertained doubts respecting the accuracy of the translation, and therefore, as far as lay in his power, supplied a list of *errata*, deduced from the analogy, etymology, and comparative philology of the words contained in them; he now begged leave to lay before the Society a translation of the inscription from Professor Westergaard's copy, which, when compared with his first deciphering, would be found to differ only in a few words, the explanations of which differences were in the notes appended to his translation.

In conclusion, the author states, that as yet he does not feel quite competent to place before orientalists a satisfactory translation of this

inscription, because he is still doubtful of the orthographical and interchangeable value of some of the characters, which he will be better able to explain in the preface to his Zend Dictionary, where he hopes to publish the Pehlivi alphabets, with observations on their lapidary, cursive, and numismatic forms, to facilitate future investigations in the deciphering of this character.

The map illustrative of Dr. Livingstone's and Mr. Oswell's travels in Southern Africa mentioned (p. 373) is a copy of one received by Mr. Reeves from the Cape of Good Hope, and forwarded by him with copy of a letter to the Chief Secretary to Government, calling the attention of the latter to the existence of an extensive slave trade discovered by these gentlemen in the countries to the east of Lake Ngamee. In this letter Mr. Reeves states as follows:—

"You will observe in the upper left hand corner of the map, a notice of a tribe called 'Membari,' to the following effect:—

"'The Membari came to Sebitoane in 1850, bringing a large quantity of English clothing, viz. printed cottons, coloured, and bartered for about 200 slaves. By their suggestion the Makololo went on a foray against the Bashukulompo—the Makololo to receive all the cattle, the Membari all the captives, in consideration of the use of their guns in the attack.'

"Sebitoane, as will be found explained in the right hand upper corner of the map, is the chief who rules over the well-watered country shown in the centre. The Makololo are a tribe under his rule. The Membari most probably communicate between the sea coast and the great lake by means of the 'Zambezi' river, a magnificent stream, which, after receiving the waters of many rivers in the neighbourhood of the lake, flows across an unexplored tract of country, and it is conjectured falls into the Mozambique a little to the north of Sofala.

"It appears probable that Major Hamerton, Political Agent at Zanzibar, may, through His Highness the Imam of Muscat, be able to procure much valuable information connected with the proceedings of the slave dealers, Portuguese, or whoever they may be, and to ascertain whether the Membari are Europeans or Natives employed by them; and the result of his inquiries, communicated to the British Admiral commanding at the Cape of Good Hope, will enable that officer to check their nefarious traffic. Perhaps, too, the Imam may have it in his power to interfere actively for the prevention of the slave trade himself.

"Subsidiary to the above object, accurate information is required in reference to the means of communication between the coast and the

great lake. The river 'Zambezi' especially is an object of the greatest interest. It is a branch of the 'Zambezi' set down in our maps between the 15th and 20th parallels of south latitude. If Major Hamerton could determine this, and lay down with any accuracy the point of junction of the branch with the main stream, or procure any information on the means afforded by these streams for navigation, and the nature and distance of the country traversed by the branch from the sea to the great lake, he will add a most interesting and useful supply to our geographical knowledge, for so late as this morning I read an account in the *New Quarterly Review* of a journey accomplished by Mr. Francis Galton from the Western Coast of Africa to the Ngamee lake, without much difficulty; so that the supply of the above information regarding the 'Zambezi' is now all that is requisite to complete the chain of discovery across the continent of Africa from sea to sea."

Through the kindness of Lieutenant Close, of the Engineers, a beautiful copy of the Koran, written on a scroll 10 feet long, and 3 inches broad, making in all a roll 3 inches long and $\frac{3}{4}$ inch in diameter, was laid before the Members, and much admired.—*15th September* 1853.

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With reference to the Government Circular No. 3419, dated 10th instant, forwarding printed copies of a further despatch from the Honorable the Court of Directors, respecting the Universal Exhibition of Agricultural and Industrial Products about to be held by the Emperor of the French at Paris in 1855, and requesting that the greatest publicity might be given to the same, the *Secretary* was directed to have recourse to the best measures in the Society's power for carrying the request of Government into effect.

Dr. Stevenson stated, in defence of his position, that the Tithyas of the Buddhists and the Gymnosophists of the Greeks were Digambar Jains, that the work called the Kalpa Sutra, the most sacred book of the Jains, gives us a regular succession of Hind teachers, with probable dates and terms of life back to B. C. 569, and places the previous great teacher Parsoonath only 250 years earlier, assigning to him a life of 100 years; whereas the Buddhists carry us back with probable dates only to 543, but throw the predecessors of Buddha back to an almost illimitable distance, and therefore that this book has more internal probability in reference to those times than those of the Buddhists.

That the Tithyas agreed with the Gymnosophists in rejecting all articles of dress, that the usage is commended in the Jain books, while

in all the Hindu books of authority it is reprobated, and therefore, that as Jains then existed, and in their system alone does such a usage as that intimated exist, the conclusion must follow that they belonged to that sect.

The following observations are appended by Mr. Pestonji Behramji to the re-examination of his translation of the Pehlivi inscription at Haj-i-Abad :—

"Modern Zoroastrians, and especially those of the sacerdotal order, to which I have the honour to belong, have often been accused of ignorance, not only of the ancient literature of Persia, but also of the language in which their sacred and religious works are written, as well as the characters which are inscribed on the rocks near the relics of antiquity abounding in different parts of Persia. With a view to remove this reproach, I have attempted to decipher the Pehlivi inscription at Haj-i-Abad, near Nuksh-i-Rustam, in Persia.

"When I first attempted this in January last, I had access to only one copy, as published in Sir R. K. Porter's Travels, which appears to be imperfect and erroneous in many places; but through the kindness of Mr. Dhunjibhoy Framji, a much better and more correct copy, as recently taken down, apparently with great care and attention, by Professor Westergaard, and published last year at the end of his lithograph edition of the Bundehesh was placed at my disposal in June last. This has cleared up several ambiguities, and has enabled me to make several modifications and corrections in my original decipherment and translation.

"I have not spared any pains to render my decipherment and version faithful and accurate. I therefore have no hesitation in submitting the result to the criticism of the European public, if whose discerning judgment be in my favour it will go far to establish the genuineness and antiquity of several of the Pehlivi works now in the possession of the Parsees of Western India."

This translation does not differ essentially from that presented by Mr. Dhunjibhoy Framji at the last meeting of the Society. They will both, with the inscription in original and in Gujarathi transcript, be published in the next number of the Society's Journal.

With reference to the presents for the museum mentioned, (p. 369,) the *Secretary* stated that collections 1 to 3 inclusive were from the tertiary formations of the Persian Gulf and Arabian Sea, well described and illustrated in Colonel Grant's Geology of Cutch.

The fossil oyster bed in the limestone at Minora Point, Kurachee, in Cutch, and on the Arabian Coast, seems equally to characterise the

tertiary formation on the coast of Kattyawar; for among the fossils of the 2nd collection are specimens apparently identical with the oysters and the limestone of these parts in which they are imbedded, which came from the summits of low hills (50 to 150 feet high) on the western coast of Kattyawar.

The small, but extremely interesting collection of fossil shells presented by Major General Cullen, also belongs to this tertiary formation. Several are identical with those figured and described by Sowerby in the work just mentioned. They are in an exquisite state of preservation, not having yet become connected with the material in which they are imbedded, and never having been worn by the action of the waves. The fact of their underlying the lateritic cliffs and beds of lignite, mineral copal, &c. of Quilon and the neighbouring coast, proves that the latter are not so old, geologically considered, as the tertiary formation.

Captain Nicolls' beautiful collection of cut and polished woods, as well as shell-deposits of the eocene lacustrine formation, seems to indicate that there are fossils not only of the latter, but also of the Oolitic (?) sandstone of India about Saugor; at all events the cast in limestone, apparently of a large *turbo*, among the collection, show that this at least is of marine origin. The section of the elephant's tusk imbedded in the Nerbudda calcareous conglomerate probably came from the same species as that presented to the Society by Dr. Bradley, which he obtained from the banks of the Godavery. Both are $7\frac{1}{2}$ inches in diameter, and solid; the hollow portion at the base of the Godavery one gives an arc of a circle about $11\frac{1}{2}$ inches in diameter. Baron Hugel mentions one from the island of Perim, opposite the mouth of the Nerbudda, which was $10\frac{1}{2}$ inches in diameter; and Mr. Dean saw one from the bed of the Jumna which he imagined to be at least eight inches in diameter. The latter appears to have been in a friable state, like those of the Nerbudda and Godavery, for the sepoys were making use of it for pipe clay. These seem to be the largest tusks on record.

The minerals collected from the Rewa Kanta by the late Major Fulljames are of great interest in an economical point of view. Iron ores of the richest kind evidently abound there, in the same forms as in Malwa and in the Southern Mahratta Country, at the opposite or southern boundary of the great basaltic region of Western India. Limestone, too, appears to be a part of the same formation; so that with this flux on the spot, all that appears wanting is the proximity of coal to make these ores highly available—a *desideratum* well known to Major Fulljames, who, led on by the rich mineral specimens afforded by this interesting district of which he was Political Agent, probably

contracted that fever, in his great zeal for their full development, which has so suddenly cut short his useful career. By his death the Society has lost an original observer and a valuable contributor; and the Government an officer whose love for geological and mineralogical research would have soon tested the economical resources of the Rewa Kanta in this respect to their utmost.—*20th October* 1853.

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As the letter from Professor E. B. Eastwick applied for a copy of the Society's Journal in virtue of his membership, it was resolved that at the Anniversary Meeting a proposition should be brought forward to entitle any Member out of India to that claim on payment of the annual subscription of non-resident Members, viz. Rs. 15.

The copies of the Society's Journal applied for by Professor Eastwick for the public Library at Berlin, the Library of the East India College, and for himself, had been forwarded by the last mail.

Of the sepulchral urns presented by Mr. Barker, he states that they were found in a mound called *Tel Balari*, in the vicinity of Bagdad, which was excavated under his direction. After having dug a large tunnel of 60 feet long, and about 20 feet below the surface, he came upon a wall composed of kiln-burnt bricks, of the same size as those found at Babylon, but, with the exception of one or two, having no inscription on them; and on breaking through this wall, he found it to be the side of a sepulchral vault, containing about 150 urns, piled upon one another about ten feet deep, in a semi-circular form. Some of these contained calcined bones and ashes, also pieces of vitrified earth, glass, and beads; others were filled with fine powder, and some were empty. All were lined with bitumen. The mound had not been previously opened.—*17th November* 1853.

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## ANNIVERSARY MEETING.

### MONDAY, 28TH NOV. 1853.

### *Report of the Committee of Management.*

The proceedings of the past year indicate a favourable advancement in every department of the Society.

Sixteen resident, seven non-resident Members, and two Subscribers, have been elected, that is four non-resident Members and two Subscribers more than last year, with an equal number of resident Members.

Eighty-two pamphlets and books have been presented, twenty original communications, and sixty donations to the museum, among which are upwards of 1,000 mineralogical and geological specimens.

To the library 138 works, comprising 227 volumes, have been added by purchase, and these have not been so exclusively confined to two or three classes, as in former years, although the general reader can still claim by far the greater share. The number of literary and scientific periodicals is the same, viz. 40, and the newspapers have been increased by 8, making in all 21.

The chief improvement that has taken place in the library during the past year is the number of works that have been bound and repaired; this amounts to 512, or 1,289 volumes, many of which have been folios and quartos, among which, again, may be included some of the largest books in the library.

The frame-work for the newspaper room sanctioned by the Society at the last Anniversary Meeting has been erected, and, with the exception of a few files, the whole of the newspapers are now stitch-bound, lettered, and conveniently arranged. The alphabetical catalogue, which it was hoped would have been completed by July last, has, until lately, been very slow in its progress, but now that the plan in which the books should be arranged has been laid down, four cases have been numbered and lettered in accordance with it, and the rest may be expected to speedily follow.

The museum is steadily advancing towards an instructive state, and the additions which it has received during the past year have been both numerous and very valuable. Central India, Scinde, the Rewa Kanta, the Southern Mahratta Country, and the Salt Range of the Punjab, have all afforded rich illustrations of their mineralogy and geological formations, through the kindness of the gentlemen whose names are mentioned after respective presents in the list of donations to the museum, where the latter will be found more particularly detailed.

The report of the Cave-Temple Commission informs us that several accounts of Buddhist Cave-Temples and remains have been received, among which the most interesting are those of Lower Scinde, discovered by W. Cole, Esq., and communicated through H. B. E. Frere, Esq., Commissioner in Scinde; of Koolvee in Malwa, by Dr. Impey; and of Baitalbaree and Dowlatabad, in H. H. the Nizam's territories, by Dr. Bradley. All the impressions of the cave-temple inscriptions taken by Lieutenant Brett have been reduced and lithographed under the superintendence of the *President*, the Rev. Dr. Stevenson, who has added translation and remarks on a part of them, which have been

published in No. XVIII. of the Society's Journal, and the other part is now being printed in the forthcoming one. There are still several inscriptions, however, in different parts of the Presidency of Bombay, which have not been taken, but the Cave-Temple Committee is not without hope, that by the kind assistance of Government, impressions of these also will shortly be obtained. Mr. Fallon, the artist, has completed the illustrations of the caves of Elephanta, and is now far advanced with those of Karlee.

The Society has published the usual number of its Journal for 1852, viz. No. XVII., also another No. viz. XVIII., in July last, and the number for the present year, which is now in the press, will appear in January next. It is a source of much gratification to your Committee to be able to state, that the increasing demand for the Society's Journal both in India and Europe promises favourably for its increasing usefulness.

The balance in favour of the Society exceeds that of last year.

This Report was received, and the best thanks of the Society voted to the Committee of Management for their valuable services during the past year.

*Election of Vice-President.*

His Excellency Lieutenant General the Right Honorable Lord Frederick Fitzclarence, G.C.H., *Vice-Patron* of the Society, was also elected *Vice-President.*

The following gentlemen were elected for the Committee of Management, Museum Committee, and Auditors for the ensuing year :—

*Committee of Management.*

| | |
|---|---|
| William Howard, Esq. | Capt. J. G. Forbes. |
| Lieut. Col. J. Holland. | Thos. L. Jenkins, Esq. |
| A. H. Leith, Esq. | John Ritchie, Esq. |
| Rev. P. Anderson, A.M. | M. Stovell, Esq. |
| John Harkness, Esq., A. M. | C. J. Erskine, Esq. |

*Museum Committee.*

| | |
|---|---|
| A. H. Leith, Esq. | George Buist, Esq., LL.D. |
| H. Conybeare, Esq. | R. S. Sinclair, Esq., A.M. |
| J. Harkness, Esq., A.M. | H. J. Carter, Esq. |

*Auditors.*

| | |
|---|---|
| Captain G. J. Forbes. | H. B. Gilmore, Esq. |

The following proposition was carried :—

"Members on leaving India shall, by a deposit of Rs. 50, be entitled to a copy of all subsequent publications of the Society."

JOURNAL

OF THE

BOMBAY BRANCH

OF THE

ROYAL ASIATIC SOCIETY

JANUARY, 1855.

ART. I.—*The Tithyas, or Tirthakas of the Buddhists, and the Gymnosophists of the Greeks, Digambar Jains.* By the Rev. J. STEVENSON, D.D., President.

Read October 20th 1853.

ALTHOUGH much obscurity still rests upon the Buddhist religion, especially in reference to its rise, and the relation it holds to other systems now prevalent in India, light has of late begun to break in upon this interesting subject. The publication of Burnouf's History of Buddhism, embodying large extracts from original documents now existing in Nepaul, of which copies were transmitted by Mr. Hodgson to Europe, and the translation of similar documents found in Ceylon by Mr. Hardy, furnish unquestionable proof, that when Buddhism sprung up, five and a half centuries before the Christian era, the whole of Indian society was under the influence of the present Brâhmanical institutions; and to me it appears as evident that Jainism had begun that opposition to the prevalent ceremonial system, which was afterwards more vigorously carried on under the banners of Buddhism. Slaves as the Hindús at first sight appear to be to priestly domination, there has always been, and still is, a party among them opposed to the

dictation of the Bráhmans, and seeking something more spiritual and liberal than their ritual affords.

It is a singular fact that the first innovations on the ancient ceremonial system are traced back both by Bráhmans and Jains to Rishabha, a sovereign who stands near the top of the list of their heroic kings, and father of that Bharta, from whom India received its indigenous name; and who, according to the most moderate computation, must have lived four thousand years ago. The account given of him in the Bhágavat, the great Bráhmanical authority, is the following :—

"After having installed Bharat, the eldest of his hundred sons, in the sovereignty over the earth, this accomplished servant of the Lord, and friend of man, devoted himself to God. Preserving nothing that belonged to him, with his body naked, his hair disordered, and like one deranged, having drank the ashes of the consecrated fire, he went forth as a mendicant in the land of the Bráhmans." *

The Jain account of Rishabha, in the Kalpa Sútra, is that he was "the first king, the first mendicant, and the first Tirthankara."† It is also said that "Achailakya (want of clothing) is the attribute among the Tirthankaras of Rishabha and Mahavíra alone." ‡

How far any regularly organized and permanent opposition to the ancient ceremonial took place at this early period cannot with certainty be determined. The probability is that ritualism and liberalism were both then, and long after, without system. The next great opponent after Rishabha to the prevalent ceremonialism, as far as we can gather from the tradition of those times, was Kapila; but although the spirit of his philosophy is in direct contradiction to the Vedas,—the only sacred books that seem to have existed among the Bráhmans in his time,—he never separated himself from their religious community, and his influence was too great to permit of this being effected by others. Modern Hindú writers, however, have denounced his system, in which everything is deduced from nature, without the intervention of a deity, as dangerous, and called it the atheistical Sankhya. This is the scheme of philosophy that was anciently so popular among the Buddhists and Jains; and the Bráhmans, in order to adapt it to theism, added a deity, to whom they assigned the heartless task of looking on unconcerned while nature was evolving from her fertile womb the elements of things.

* Bhágavat Purána, book v. chap. v. 28.

† Translation of Kalpa Sútra, chap. vii.

‡ Translation of Kalpa Sútra, Introduction, p. 3.

The town of Kapilavasta, named after this sage, was famous in ancient times, and we have no good reason to doubt that Kapila was a historical personage, though the time in which he lived is involved, like most subjects of Hindú chronology, in almost impenetrable obscurity ; yet the place he holds in Indian tradition leads us to conjecture that he flourished above a thousand years before our era.

After Kapila the next liberal philosopher who exerted a great influence on the mind of India was Parshvanáth, the author of the Jain religious system, who flourished eight and a half centuries before the Christian era. According to the Jains, he was the son of a king of Benares, lived a hundred years, and died B. C. 828. He is reckoned twenty-third in the number of their Tirthankaras, has temples specially dedicated to him, and is held, with Rishabha and Mahavíra, still in special veneration. Among the Hindús generally he is much better known as the object of Jain reverence than any of the rest of their sages, and is alone specially invoked in the introduction to the most sacred of Jain works, the Kalpa Sútra ; leading to the idea that he is the real founder of the sect.

After him, the next great teacher of the Jain system was Vardhamána, styled Mahavíra (the great hero), son of Siddhártha, the petty raja of Kundagráma, a town and district in Behár. His death took place B. C. 569, at the age of seventy. His chief disciple at that time was Gotama Indrabhútí, destined to become the famous Buddha, and to spread the religion of human reason and asceticism more widely in Eastern Asia than has happened to any other religious system. Mahavíra had innovated on the system of his predecessors, and to show his entire freedom from human passions, dispensed with the mean apparel which, for the sake of decency, ascetics till then continued to wear. After his death a split took place among the members of the Jain community, the majority adhering with Sudharma to the system of their preceptor, but an influential minority, with Gotama at their head, returning to the institute of Parshvanáth in respect of decent apparel.

Lists of the head teachers of the disciples of Mahavíra, or original Jains, have been handed down to us, of so trustworthy a character, and bearing so much internal evidence of truth, that it is impossible to deny their genuineness, as any one may satisfy himself by looking into the Sthirávali of the Kalpa Sútra ; but owing to the prevalence of Buddhism for several centuries after its rise, Jainism, though not extinct, sank into comparative obscurity.

Gotama, the Jains maintain, was originally a Bráhman, but the

Buddhists affirm that he was the son of Suddhodhana, a petty raja in Behár. However this may be, we cannot allow him the merit or demerit, as the case may be considered, of inventing the system he so widely propagated. The Buddhists themselves mention five other ascetics, no doubt belonging to the Jain minority, who consorted with Gotama before he became Buddha. These, it is true, for a time deserted him, but they all returned on his attaining Buddhahood, and proved exceedingly useful to him in the propagation of his system. The essential elements of both his system and that of the Jains is the philosophy of Kapila—the deification of nature; a spiritu-material pantheism, with the peculiarity that certain natural elements are capable of pressing themselves forward, so as to acquire omniscience. These extraordinary beings are called by the Jains Tirthankaras, and by the others Buddhas.

In thus adopting in the main the Jain account as that based on fact, in opposition to the account of the rise of Buddhism given by its own adherents, I was guided at first solely by the consideration that the Jains give us probable facts, and dates, and terms of human life, back to B. C. 828, while the Buddhists do so only to B. C. 543; but the following considerations, taken from Buddhist documents themselves, will fully confirm the previous existence of the Jains as a religious party.

In the Buddhist documents preserved in the north of India, and analyzed by Burnouf, and in the Ceylonese writings translated by Hardy, frequent mention is made of a class of opponents encountered by Buddha, usually named Tithyas or Tirthakas. This word, however, is used synonymously with Tirthakaras, the Sanskrit form of the word Tirthankara, a name appropriated by the Jains to their deified religious legislators.* In several passages the Tithyas are distinguished both from Bráhmans and Buddhists. Thus Raktaksha is said to have gone to a place where there were Tirthakas, S'rámanas, and Bráhmans, ascetics and mendicants.† Not having the original before me, I can only conjecture that the two last mentioned parties were Vánprasthas, and Sanyásis, and the third common Bráhman householders. The second were certainly Buddhist ascetics; and it seems to me there can be as little doubt but that the first were Jains. In the same way, in the Lalita Vistara, the Tirthakas are mentioned among the auditors of Buddha as a sect different from the Bráhmans, in a passage in which, perhaps, the original terms are the same as those of the passage cited

* Burnouf, Histoire du Buddhism, vol. i. p. 515, and onward.

† Burnouf, p. 172.

above.* In Turnour's Páli Buddhistical Annals the Tithyas are also mentioned, and named heretics.† In the Buddhist documents the Bráhmans are always correctly described, and well characterized, as in the following passage, where Buddha, after partaking of a feast prepared by a Bráhman for him and his disciples, is said to have spoken as follows :—" As the offering of the Bráhmans cannot be presented without fire, unto him fire is the principle requisite : as a knowledge of the science of recitation is required by him who recites the Vedas ; as the king is the chief of men ; as all rivers are received by the sea ; as the sun and moon are necessary to the science of the astronomer, so to him who would acquire merit by the giving of alms Buddha and his priests are the principal requisites." ‡

Again, Buddha and his priests on a certain occasion are said to have fallen in with a certain ascetic Bráhman called Bawari, who taught " the three Vedas," but neither he nor any other Bráhman is ever called a Tirthaka. The authors of those books, then, knew full well what a Bráhman was, and describe him as we now find him. Let us next see how they describe the Tirthakas.

One of the principal Tirthaka opponents of Buddha is thus censured by a favourer of Buddhism :—" Comment peut-il être sage celui qui, portant les signes de la virilité, &c. promène nu dans le village, aux yeux du peuple ? Celui qui suit la loi couvre le devant de son corps d'un vêtement."§

In Harvey's Manual of Buddhism we are told that this Purána was called also " Purṇá-Kasyapa-Buddha, because he had overcome all evil desire."

Further, it is said—" The people brought him clothes in abundance, but he refused them, as he thought if he put them on he would not be treated with the same respect. ' Clothes,' said he, ' are for the covering of shame ; shame is the effect of sin ; I am a *rahat*, and as I am free from evil desire, I know no shame.' The people believed what he said, and worshipped him. Five hundred other persons became his disciples, and it was proclaimed throughout all Jambudvipa that he was Buddha."‖

It is noticed particularly of another Tirthaka opponent of Buddha,

* Lalita Vistara, Cal. edn. p. 2, l. 3 from the bottom. The words are as follows :—अन्यतीर्थिक श्रमण ब्राह्मण चरक परिव्राजकानां. Jains, Buddhists, Bráhmans, eremites, and mendicants from other quarters.

† Jour. As. Soc. Bengal, vols. vi. and vii.

‡ Burnouf, p. 275.

§ Burnouf, pp. 187, 188.

‖ Harvey, p. 291.

that he wore no clothes.* A third boiled all his water ere he drank it, and a fourth condemned the eating of flesh.†

There are two grand characteristics, then, of those Tirthakas, which are in exact agreement with the oldest books and traditions of the Jains—the existence among them of Digambar sages, and the total abstinence from animal food. Neither of these are applicable to either the Bráhmans or Buddhists of ancient times.

In all the Bráhmanical works no follower of the religion of the Vedas is mentioned, with the single exception of Rishabha, who went about unclothed. Against following his example the Bhágavat puts in an express caution, and says that those who now do so "are infatuated by necessity, under the evil influence of the Kali age."‡

The Vishnu Purána, when it describes Vishnu as assuming the form of a sage to deceive mankind, describes him as a Digambar Jain, in the semblance of a naked mendicant, with his head shaven, and carrying a bunch of peacocks' feathers.§

The Jains are evidently intended in this passage, though it is usual to say that the ignorance of the Hindú annalist has led him to confound them with the Buddhists.

In Manu the ascetics of the third or Vánprastha division of Bráhmans are directed to clothe themselves with the "skin of an antelope or the bark of a tree," and the Sanyási or fourth order are also directed to be dressed in "coarse clothing."‖

Hodgson, indeed, mentions that there is an isoteric or tantrical theory of Buddhism known in Nepaul, the pictures representing the sages of which make them appear as entirely unclothed; but no such sages are acknowledged among the pure Buddhists of the present day; and the adoption of such a usage is entirely in opposition to the practice and precepts of Buddha, as contained in the documents transmitted to M. Burnouf by Mr. Hodgson himself, which expressly condemn the Tirthakas for this very practice.

In reference to abstinence from animal food, this seems to have been an original institute of the Jains, or at least early introduced by them. Buddha would not kill an animal, it is true, for food, but he would eat its flesh, and the last meal he partook of was a dish of pork, prepared by a disciple named Chundo.¶ According to Manu, the feast in honour

* Harvey, p. 330. † Harvey, p. 292. ‡ Bhagavat, books v. and vi. 2.

§ Vishnu Purána, books iii. and xviii. ‖ Manu, book vi. 6, 44.

¶ Turnour. Jour. As. Soc. Bengal, vol. vii. p. 1003. This fact is also noticed in Burnouf and Harvey.

of deceased ancestors could not be honourably celebrated without a number of kinds of flesh, and the fatted calf was killed to entertain a distinguished guest among the ancient Bráhmans as well as among the Jews.*

The Tirthakas of the Buddhists, then, could be none but Digambar Jains; and the very same considerations show that the Gymnosophists of the Greeks must have belonged to the same class. They could neither have been Bráhmans nor Buddhists, but such sages as are described in the Kalpa Sútra and other Jain works, successors of whom are still met with on Mount A'bú, and the districts adjoining. Clement of Alexandria, the most accurate Greek writer on foreign matters, expressly distinguishes the Σεμνοι or Buddhists from the Γυμνοσοφισται, or naked sages, and though other writers confound them, that will not excite much surprise in the mind of any one who knows what crude notions on many Indian subjects, after so long and close an intercourse, still prevail in England.

The only persons at all within the pale of Hinduism who adopt the practice of going about naked are a sect of Kapláika Gosains, extreme votaries of Siva, who are considered as schismatics by the Bráhmans, and who are confined to the east and south of India, and unknown in the west, where the Greeks came in contact with the Hindus. Their origin, too, cannot be traced back by either tradition or ancient documentary evidence to the times of the Greek intercourse with Western India, while that of the Jains can, by traditions and writings as worthy of credit as any that exist in the country.

As, then, both Bráhmans and Buddhists, not only by their present practice, but in all their extant writings, condemn the practice of sages going about unclothed, as there is not the least evidence of any such usage having ever prevailed among either the one party or the other; as the Jains have in their sacred books laid down the want of clothing as the characteristic of their first and last deified religious legislators, and as a sect of Digambars has continued to exist among them from of old to the present day, the only conclusion that is left to us is, that the Gymnosophists whom the Greeks found in Western India, where Digambarism at present prevails, were Jains, and neither Bráhmans nor Buddhists; and that it was a company of Digambars of this sect that Alexander fell in with near Taxiles, one of whom, Calanas, followed him to Persia.

* Manu, book iii. 168—172; v. 22, 41.

ART. II.—*Buddhist Antiquities in China.* By the Rev. J. STEVENSON, D.D., President.

Presented September 15th 1853.

IN Fortune's *Tea Districts of China and India* there is an account of a curious Buddhist Inscription (plate vi.) in an island near Chusan, of which, not having yet seen any explanation, I beg to submit a translation, with remarks, to the Society.

The passage in question is as follows :—" After staying a few days at Chusan, I went onward to another of the islands, named Poo-too. This is commonly called by foreigners the ' Worshipping Island,' and is inhabited by the priests of Buddha, and their followers. I had two objects in visiting it at this time : the first was on account of my health, which was getting affected by the excessive heat of the weather ; and the second was to obtain a copy of some inscriptions which I had observed on a former occasion. When I landed, I walked over the hill in the direction of one of the principal temples, which had been built in a little valley or glen between the hills on the road-side. By the way, I came to the stones on which the inscriptions had been carved. There were two of them : they looked like little grave stones, and, as usual in such cases, each had a small place near its base for burning incense.

" The characters upon them were not Chinese, and no Chinaman could read them. I applied to some of the most *learned* priests in Poo-too, but without success. They could neither read them, nor could they give me the slightest information as to how they came to be placed there.

" The characters looked like those of some of the Northern Indian languages ; one of the stones was evidently less aged than the other. In this the unknown character was placed along the top, and a row of Chinese ones below. The latter, when read, appeared to be nothing more than an unmeaning phrase, used by the Buddhist priests at the commencement of their worship—*Nae Mo o me to ga :* what the upper line means some oriental scholar may possibly be able to say.

"The second stone was evidently very ancient. There were no Chinese characters upon this. How or when these stones were placed there, it is difficult even to form a conjecture. Buddhism we know was imported from India to China, and it is just possible that under these old stones may be the remains of some of its earliest teachers."

To any one acquainted with the Tibetan alphabet, it is easy at once to pronounce the foreign character in these inscriptions to be the Tibetan. In Devanagári and Roman letters the second and principal of them may be read as follows :—

| ब्लम | Blam. |
|---|---|
| ओं । अरकचन । ह्रीः | Om.—Arakachana Hríḥ. |
| ओं । मणिपद्मे । हूँ | Om.—Manipadme Hám. |
| ओं । वज्र-पाणि । हुँः | Om.—Vajrapani Hunḥ. |

The first inscription is nothing more than the second line of this, with a Chinese gloss below.

The general character of these inscriptions, too, is sufficiently obvious: they are Buddhist formulæ, held in great reverence by the people, especially in Tibet, where the second of them is written frequently on temples and other public buildings, and held in something of the same esteem as the Bráhmans hold their Gayatri, with this difference, that instead of seeking to conceal it, they, in accordance with the general spirit of their religion, seek to publish it. The Nepálese, however, think this wrong, and in this, as in many other things, have taken their ideas from the Bráhmans.

This formula has exercised the ingenuity and learning of Klaproth, Hodgson, and Mill; and were it not that the accompanying formulæ, as I think, throw additional light on it and the whole subject, I might be spared any remarks upon it.

The whole of the formulæ then, I think, belong originally to the Hindú Tantra, though they are capable also of receiving an orthodox Hindú, a mystical, and a popular Buddhist interpretation.

In a Tantrika tract, the नवार्णन्यास *(Navárnanyása)*, which I have now before me, I find ह्रीं very frequently used, and among other symbols also हूँ and हुँ. I asked a Bráhman to write down the Hindú symbol corresponding to those in our inscription, and he gave me ह्रीं, हूँ and हुँ: The correspondence of these with those in our inscriptions is striking, and plainly points to the source whence these sacred symbols of the Buddhists was originally derived. In the last of the Tibetan

formulæ it will be observed that the nasal mark is combined with the visarg, a combination that neither in the ancient Vedic nor modern Puránic Sanscrit can occur. It is a peculiarity of the Tantrika mantras. That this is no casual reading will appear from Klaproth's fac-similes, three of which are the same as ours, though he gives no explanation of the visarg, but assumes the word to be the Sanscrit हूम्, meaning *verily, amen.*

The original sense, then, of these Tantrika symbols at the end of each of the lines, would be expressed according to the left-handed scheme by मद्यालय, मैथून, मणि; in the right-handed system by Sakti, Ganesa, and Siva; according to mystical Buddhism by Adi Pradnyá, Sanga, and Buddha; or the Isis, Horus, and Osiris of the ancient Egyptians, which we might interpret Nature, the World, and God, with some accommodation of the terms to our modes of thinking, as those acquainted with Hindúism will easily perceive. All these Tantrika symbols are to be considered as nouns in the vocative, or interjections, having no variation on account of case.

It is only necessary to notice in passing, that the initial ओं is the popular Hindú symbol for Bráhma, Vishnu, and Siva; the Buddhist for Buddha, Dharma, and Sanga; and the philosophic for the eternal unmanifested essence of deity, from which all else is supposed to have sprung, and which they denominate Omkára or Bráhma.

In explaining the words in the body of each of these formulæ, we commence with the middle one, as it is by far the most common and important, and the one that is repeated on a separate stone with the Chinese below it.

It is Manipadme, "Oh jewel and lotus!" words which, again, every party may explain according to his own peculiar system. The term is, I conceive, a compound, and in the vocative case, and probably in the dual number, though this is not quite essential; but the last member must be considered feminine. From the original Tantra, again, we easily get the explanation of Siva and Sakti in India, given by Klaproth, and by parity of reasoning, Vishnu and Lákshmi, and Adi Buddha, and Adi Pradnyá; and not improbably, in the mystical system, the compounding of the two words may be taken to signify Sanga, which means union. According to Hodgson and Klaproth, in the popular Buddhist system of Nepál and Tibet, this formula is applied to the Boddhi-satwa Padma Paṇi, who is supposed at present to preside over and regulate the affairs of the world. It is this that probably has given rise to the common but incorrect reading मणिपद्म, since Padma Paṇi is looked on as a male, and not as a female. To consider मणिपद्म

a locative, and take ओं into the construction, or to supply between the two words a copulative, seems to me inadmissible.

In reference to the first formula, अरकचन, I am left entirely to conjecture: according to the radical meaning of the words, it may mean "Oh Enlightener of the age!" and be applied to the same Boddhi-satwa as the last in the popular system, or to the first Dhyáni Buddha, whose name, Vairochana, means nearly the same thing. The last formula contains the name of the third Boddhi-satwa in the Nepál Buddhist cosmogony, and may be applied to him. The vocative here is rather according to the Páli than the Sanscrit usage.

I confess, however, that I suppose our tablet refers to an earlier state of Northern Buddhism than that exhibited in Hodgson's works, in which the system is pourtrayed as it now exists, after having been greatly modified by the influence of Bráhmanism. At the time of the first introduction of Buddhism into Tibet, the triad system was popular in India, as we see from the caves of Elephanta and Ellora, and it was this system I conceive that was first carried beyond the Himalayas and adapted to Buddhism. The Hindú Quintain of Siva, Vishnu, Surya, Lákshmi, and Bhaváni, did not arise till afterwards, and it is this which seems to me to have given rise to the five Dhyáni Buddhas. "Arakachana," I suppose, then, to refer to the Creator in the Hindú sense of his manifesting or bringing the world to light; "Manipadme" I consider to be the preserving and generative power, and "Vajrapani," literally he who is armed with the thunderbolt, to refer to the destructive power of the Deity, understood, either generally in reference to the desolation of the present world, or individually as destroying those bonds of wordly desire which prevent the emancipation of the spirit. In the absence of authority, however consistent this explanation may be with eastern modes of thinking, it might seem unsafe positively to affirm that this is the true interpretation of these symbols; yet I think it sufficiently probable to form on it the translation I have given below.

I have said nothing of the pure Tibetan word at the head of the tablet translated by Csoma de Koros, a superior, or high priest, as it evidently refers to the high repute in which the prayer was held.

### Translation.

*The Chief of Prayers.*

O Triad! O Bringer of the World to light! O Nature!
O Triad! O Efficient and Material Generative Cause! O Universe!
O Triad! O Armed for the World's Destruction! O God!

In endeavouring to ascertain when this inscription was executed, we are not helped by any date contained in it, and are left, therefore, to conjecture.

As the Buddhist religion was only introduced into Tibet about the seventh century of our era, after it had begun to decline, and had been considerably corrupted in India, we must look for some period posterior to this in fixing the date of a Tibetan tablet in China; and as we learn from Desguignes* that between A. D. 763 and A. D. 842 the Tibetans were powerful on the northern frontier, and had possession of some parts of the country, it was likely during that period that a small colony of priests penetrated to the island in question, and there established the worship of Buddha, and executed the inscription which Mr. Fortune has copied.*

* Desguignes, vol. i. p. 1; article Tibet, p. 165.

ART. III.—*An Account of the Ancient and Ruined City of Brahminabad, in Sind.* By A. F. BELLASIS, Esq. [With a Plan.]

Read April, 1854.

BRAHMINABAD, or Bumbra-ke-Thool,* its more modern and Sindee name, is an ancient and ruined city, situated on the dry bed of a large river, said to have been one of the old courses of the Indus. It lies in an easterly direction about eight miles from the town of Shahdadpoor, and about twenty-one from Halla. It is about sixty miles NE. of the city of Hydrabad, and about twenty miles from the right bank of the Eastern Narra.

Brahminabad in its palmy days has been a large and fortified city, built entirely of baked bricks. Its present appearance is one vast mass of ruins, forming irregular mounds, varying in size according to the size of the original houses, of which these ruins are the humbler representatives. Some idea may be formed of the extent of Brahminabad, when I state its circumference is within a few yards of four miles, measured by a perambulator. Besides Brahminabad, at a distance of about a mile and a half is the distinct and ruined city of Dolora, the residence of its last King, and five miles in another direction is the ruined city of Depur, the residence of his Prime Minister (Wuzeer); and between these cities are the ruins of suburbs extending for miles far and wide into the open country.

Brahminabad appears to have been the commercial city, where the merchants and traders lived; Dolora, where the King and his Court resided, in luxury and pleasure; and Depur, where the Prime Minister transacted, with his officers, the affairs of State. The city of Brahminabad is entirely surrounded with a rampart, mounted with numerous turrets and bastions.

On first entering Brahminabad, so extensive and so complete are its ruins, you feel lost in contemplating its utter desolation; and it takes

* Bumbra, a name frequently applied to old ruined cities in Sind. Thool, a tower, bastion.

some time before the eye becomes accustomed to the confusion and disorder that characterise the place. After a little examination, the most prominent object that presents itself is the ruin of a high tower of brick-work standing isolated on a large heap of ruins, clearly indicating its former extent and importance. This may have been the citadel, or one of those circular towers, such as are seen in Sind to this day in the forts of Hydrabad and Omercote.

Amid the chaos of ruins you may further observe several open spaces or squares, evidently the bazars and market-places of the city: some of these are of great extent, running through the fort. A little imagination and you might picture to yourself that here were barracks for troops; that in this open space they were wont to hold their parades; that this was the exchange of the money-lenders; this the river gate of the city, where customs were levied. Again, it were easy to imagine the noble Indus gliding in a mighty stream past the city walls, her waters studded, as at present, with many a boat, and many a quaint cut sail, and many a Pulla fisherman giving perspective to the landscape. It were easier still to picture along the banks of the river, and immediately under the city walls, the busy haunts of trade: here you might say with certainty were the native craft moored to the bank; here piles of goods and merchandize were often heaped; and there, too, you might safely say were crowds of noisy, money-making Hindoos, chattering, bartering, and wrangling after the most approved fashion of modern times. Turning from the contemplation of what may have been to the chaos of surrounding ruins, the only memorials of the past, one is led to inquire what could have caused the utter destruction of a city so large and so strong.

Very little is known of the history of Brahminabad, except what tradition tells: as usual, it is mixed up with fable; but, wanting records, even fable has its value. The popular account of Brahminabad, as far as I have been able to procure it, is as follows:—

That about seven or eight centuries ago, Brahminabad was a rich and flourishing city. That in those days a very wicked King, named Dolora, reigned in those parts; and among his many iniquities he made a law that all young maidens, who married any of his subjects, were to pass the wedding night in his palace. The breach of this law was death. Now a certain rich noble had a daughter, beautiful and fair, and she was about to be married. But this law was an insuperable obstacle to the father's wishes. In his difficulties, he went for assistance to a priest of great sanctity, who was supposed to have the power of communicating with both Heaven and Hell, and asked for advice. The priest told

the rich man that he could only devise one way of helping him, and that was by destroying the whole city of Brahminabad, if King Dolora did not by a certain day abrogate this iniquitious law. The rich man besought the priest very earnestly to save the city: he offered him jewels, and silver and gold, to devise some other means; but the priest was firm, and said he had looked well into futurity, and that there was no other remedy. Then, said the rich man, save my daughter's honour, should even Brahminabad be ruined. Accordingly, there went forth a prophecy, proclaiming to all the inhabitants, that if by a certain day King Dolora did not abrogate this wicked law, Brahminabad would be utterly destroyed, and warning all faithful people to flee the city before the impending calamity came to pass. The King took no heed, and continued in his wicked ways, living in pleasure and luxury in the midst of his lascivious Court. The day came, and with it a most awful tempest, followed by a violent earthquake. The city of Brahminabnd was laid low in ruins, and in its fall, King, courtiers, and unbelievers were buried.

Those who had believed the prophecy of the priest, and had made their escape from the city before this calamity took place, are said to have wandered about Sind for a whole year, seeking for a spot whereon they might settle and build them another city. They searched in vain for a site as beautiful as that of their ruined Brahminabad; for lands as fertile and rich, for trade as great and flourishing. At last they came to Nussurpoor,* and that being the best place they had seen since they had left their own beautiful city, they settled there, and built them another brick city, and there they dwelt. This too has disappeared, and Nussurpoor is now a mud-built town, like all the rest of the towns in Sind; but the remains of the old brick city are to be seen to this day. Such is the legend of Brahminabad and its inhabitants.

I have consulted Syud Sabir Ali Shah, a learned Syud of Tatta, and have referred to the few Sindee books that give any account of Brahminabad, and from these authorities I gain the following particulars:—

The Syud states that the city appears to have been founded before the Hindoo dynasty of the Brahmins, which commenced in the first year of the Hijree, or A. D. 622. He says it is mentioned in the Toohfut-ool-Kiram that Chuch, the first of the Brahmin Kings who ruled in Sind, appointed his younger brother Chunder as his viceroy

* Nussurpoor is a city of acknowledged antiquity, and, like Brahminabad, situated on the banks of one of the old branches of the Indus. It is still a place of some repute and learning, and has a not inconsiderable trade.

at Alore, and employed himself in arranging the boundaries of his kingdom, having subdued Mah, the Chief of Sehwan, and Agheer, the Chief of Brahminabad. From this the Syud infers that the city was probably founded during the reign of the Rajahs before the Brahmin dynasty.

The Syud also states that the city must have been ruined before the expiration of the fourth Hijree century, or about A. D. 1020, as he finds it mentioned in the Toohfut-ool-Kiram, in the narration of the Soomras, that Chota Amranee, brother of Dolora Amranee, departed to Bagdad on account of his brother's injustice. This Chota Amranee embraced Islamism, and married the daughter of a celebrated Arab, whom he brought to Sind in the fourth century, together with a number of Arabs, who, in company with Syud Ali Moosooee, had been made over to him by the Khalif of Bagdad.

The Chuchnama contains a History of Chuch, the first of the Brahmin Kings of Sind, and of his dominions. It was written in the original Arabic, about A. D. 700. Therein is mentioned of Brahminabad as the chief city of one of the divisions of the Kingdom of Cyrus bin Saheeraee, who lived before the time of Mahomed. It also contains an account of the battles fought there, but mentions neither the date of its foundation nor its destruction.

The Toohfut-ool-Kiram contains a comprehensive general history of Sind, and was written about ninety years ago (A. H. 1180), and is a modern work in comparison with the Chuchnama.

The Chuchnama was written by Ali Koofee, who came to Sind with the army of Mahomed Kassim, sent in A. D. 710 by the Khalif Wulleed, son of Abdool Mullik of Bagdad. Mahomed Kassim defeated Dahir the son of Chuch, conquered Sind, and overthrew the Brahmin dynasty of kings in 711 A. D.

It was on the 11th of March 1854 that I, in company with Mr. C. M. Richardson, visited the ruins of Brahminabad.

A few officers had previously visited, at different times, these ruins, and had collected some coins and other curiosities, which are readily found on the surface, and many others had been obtained from villagers, who are in the habit of digging in the ruins for bricks, and thus find a variety of beads, stones, and coins; but no person had ever attempted systematically to excavate. Mr. Richardson and I were therefore resolved to devote two or three days to Brahminabad, and to endeavour, by carefully removing one of the heaps of rubbish, to disclose any remnants of a house that might have been concealed therein for centuries.

We selected for excavation a heap of ruins standing on the verge of

the principal bazar or square. We had not commenced many minutes before we came upon the edge of a wall: clearing it, we soon came upon a cross wall, and then upon another, and another, until a house with a variety of rooms began fast to take shape, and disclose its proportions. We had not dug two feet before we came to quantities of bones, and at that, and greater depths, skeletons were so numerous that it was hardly possible to dig a powra* full of earth without bringing up particles of bones. As far as I could judge, many were undeniably human bones, and others those of cattle and of horses. The human bones were chiefly found in doorways, as if the people had been attempting to escape, and others in the corners of the rooms. Many of the skeletons were in a sufficiently perfect state to show the position the body had assumed; some were upright, some recumbent, with their faces down, and some crouched in a sitting posture. One in particular, I remember, finding in a doorway: the man had evidently been rushing out of his house, when a mass of brick-work had, in its fall, crushed him to the ground, and there his bones were lying extended full length, and the face downwards. These bones, on exposure to the atmosphere, mostly crumbled to dust, and it was very difficult to obtain anything but fragments. But in excavating, you often obtain a good section of the skeleton, and thereby can easily tell the position of the body.

Besides bones, I found large quantities of pottery in great varieties, and much of it of a very superior description to any I see now-a-days in Sind. A good deal of the pottery was glazed in colours, of great brilliancy, and some of the vessels are of a fine kind of earthenware or china. Pieces of glass and crystal were also found, both in the excavations and on the surface of the ruins, in quantities, and the glass of all kinds of colours. Fragments of cups, bottles, and platters were very numerous. Some of the glass was beautifully stained of a deep blue colour, and other portions were worked in raised and ribbed patterns, displaying a high standard of art in their manufacture. Stones for grinding grain; others for grinding curry-stuff, and some for mixing paints; several stones for sharpening knives and tools; severals large pieces of korundum or emery, also used by cutlers to sharpen swords and instruments; quantities of cornelians and cornelian chips, and agates, and other pretty stones; balls, beautifully turned, of ivory, agate, and marble; coins, chiefly of copper, some few of silver; beads and ornaments of cornelian and glass, in every variety. In one of the rooms I found a large grain jar, ribbed in circles; its mouth was arched over with brick-work.

* The powra is a large hoe, in general use in Sind for digging, but a very bad instrument for excavating ruins, as it is very liable to break anything found.

I at first took it for a well, but afterwards discovered it to be a sunken grain jar. The diameter of its mouth was two feet, and inside it was empty for four feet, the bottom portion being filled with mould, possibly the decomposed remains of the grain.

The city must have been famed, like the present cities of Ahmedabad, and Cambay in Guzerat, for its works in cornelians and agates; and it is probable that it was from that province that a trade was carried on for these stones. There are no cornelians of the kind found indigenous in the alluvial plain around Brahminabad, and the mines of Kupperwunj in Guzerat are probably the nearest place from which they could have been imported. From the quantity of cornelians, chips, &c., besides grinding and sharpening stones, found in the excavations, I am led to conclude that the house excavated must have been inhabited by a lapidary.

Among the copper coins are many of liliputian size,—so small that their value in the present day would hardly be calculable. In a city where such coins were employed in the most ordinary and daily money transactions, how cheap must have been the price of food?

Among the curiosities found at Brahminabad, showing an advanced state of art, are some beautiful engravings on cornelians and agate. Many of them are perfect gems of art, and, like the intaglios of Rome, are polished on the inside of the device,—an art, I believe, now lost. Some that were found had upon them a bull, and others a lion; some merely a name in Arabic, and some in characters resembling the Devanagree or Sanskrit: most of these appeared cut in ovals and circles, and would be well suited for the purpose of a signet ring; others were ready cut into these shapes, but without any inscription or device, as if the engraver kept an assortment for the choice of his customers, who had only to express their wish—what device, what name—and the hand of the cunning artist was prepared to make any engraving ordered.

I am not aware that lapidaries of the present day are able to produce figures and patterns upon cornelians without making an incision in the stone,—no process of burning, no application of acid, will leave a permanent mark upon a cornelian; but yet at Brahminabad many of the cornelian ornaments are found figured with various patterns in white lines, on a perfectly smooth surface, and, after having withstood the damp of ages, are, when dug up, quite fresh.

Among the glass discovered, were several pieces in a state of decomposition, some with all the beautiful metallic colours of the soap-bubble, some that had become quite opaque, and other pieces with both sides in the last stages of decay, and only a thin fibre of glass in the centre. To describe the process of decomposition in glass, I cannot do better

than give Sir David Brewster's opinion on similar pieces of ancient glass found by Mr. Layard at Nineveh.*

Finding glass in this decomposed state is testimony of the antiquity of

* *Sir David Brewster's Opinion on the Ancient Glass found at Nineveh.*

"The different kinds of glass in common use consist of sand or silex, combined, by fusion, with earths, or alkalies, or metals, which either act as fluxes, or communicate different colours or different degrees of lustre, or refractive power, to the combination. In quartz, or rock crystal, which is pure silex, and in other regularly crystallised bodies, their molecules or atoms unite in virtue of regular laws, the pole of one atom uniting with the similar pole of another. Such substances, therefore, do not decompose under the ordinary action of the elements. The lens of rock crystal, for example, found by Mr. Layard at Nineveh, is as sound as it was many thousand years ago, when in the form of crystal.

"In the case of glass, however, the silex has been melted and forced into union with other bodies to which it has no natural affinity; and therefore its atoms, which have their poles lying in every possible direction, have a constant tendency to recover their original positions when in the state of silex. For the same reason the earths, or alkalies, or metals, with which the atoms of silex have been constrained, by fusion, to enter into union, all tend to resume their primitive state, and separate themselves from the silex.

"Owing to the manner in which melted glass is cooled and annealed, whether it is made by flushing, or blowing, or moulding, the cohesion of its parts is not the same throughout the mass, and consequently its particles are held together by different degrees of force, varying in relation to points, lines, and surfaces. No atom of the flux or other ingredient may be less firmly united to an atom of silex in one place than in another, depending on the degree of heat by which they were united, or upon the relative position of the crystalline poles of the atoms themselves when combined. There are some remarkable cases where flint glass, without any rude exposure to the elements, has become opaque; and we have seen specimens in which the disintegration of the same kind of glass has commenced a few years after it was made. In general, however, the process of decomposition is very slow, excepting in stables, where the presence of ammonia hastens the decomposition, and produces upon its surface all the beautiful colours of the soap-bubble.

"It is, however, from among the ruins of ancient buildings that glass is found in all the stages of disintegration; and there is, perhaps, no material body that ceases to exist with so much grace and beauty when it surrenders itself to time, and not to disease. In damp localities, where acids and alkalies prevail in the soil, the glass rots, as it were, by a process which it is difficult to study. It may be broken between the fingers of an infant, and in this state we generally find in the middle of it a fragment or thin fibre of the original glass which has not yielded to the process of decay.

"In dry localities, where Roman, Greek, and Assyrian glass has been found, the process of decomposition is exceedingly interesting, and its results singularly beautiful. At one or more points in the surface of the glass the decomposition begins. It extends round that point in a spherical surface, so that the first film is a minute hemispherical one of exceeding thinness. Film after film is formed in a similar manner, till perhaps *twenty* or *thirty* are crowded into the tenth of an inch. They now resemble the section of a pearl, or of an onion; and, as the films are still

Brahminabad: if other evidence be wanting, we have it in the decomposed state of the bones. These bones I have shown to several medical men, and they are all agreed that they are of great antiquity. Dr. Beatty in particular, when he examined a skull and several other bones, told me that he did not recollect to have seen bones in any museum apparently of such great age; that all animal matter in the cellular cavities of the bones was completely exhausted, and that such a process of decay would take centuries of time so completely to effect.

I am aware that in certain soils the decomposition of bone is very rapid: thus in graveyards, where the soil is wet and clayey, instances are not uncommon that after a body had been buried forty or fifty years, not a vestige of a bone could be discovered, so complete and rapid had been the process of decay; but in soil like that of Brahminabad, dry alluvial sand, upon which rain rarely falls, I presume decomposition would be very gradual.

Of the bones found, many were unquestionably human, others the bones of camels, horses, oxen, dogs, and fowls. In one of the rooms excavated, among a number of bones, we came upon a quantity of stuff that looked very like ashes, but which I believe to be the remains of smaller bones, whether of men or animals, reduced to dust. A bushel of it might have been collected, and there are two bottles full of it among my collection from Brahminabad. Many of the teeth found are curious, and show the signs of great antiquity: the enamel on some is pretty perfect, but is very liable to peel of with the slightest pressure.

A variety of women's bangles or bracelets were also found; some of glass, others of brass and copper, and a number of ivory, worked over in patterns.

Among the collection are two round solid balls of pottery, the use of which it is difficult to imagine. The most probable supposition is that they were used as missiles, and may have been employed by the defenders of the city against an invading force.

The most curious relic* I found was a hexagonal cylinder, of what I

glass, we see brilliant colours of thin plates when we look down through their edges, which form the surface of the glass; these thin edges, however, being exposed to the elements decomposed.—*Layard's Nineveh and Babylon.*

* Another curious relic of antiquity, which I have very recently received from Brahminabad, is a brazen horse, with a rider thereon. It is caparisoned with a bridle, martingale, and a necklace ornament. It has no saddle, nor saddle-cloth, and its rider rises centaur-like out of the back of the horse. The horse stands about 5½ inches high, but I regret to say the head and shoulders of the rider have been broken off. I also found a small brazen bull, worn probably as a charm, half an inch in height.

imagine to be wood, or perhaps ivory, with an inscription in Arabic in cufic characters on each side. It is three inches in length, and two and three quarters in circumference. It was probably a talisman or charm, which, when wrapped up in silk or leather, was worn round the arm or neck. It was unfortunately fractured soon after it was discovered, and has been put together with glue by Mr. Richardson. The Arabic inscriptions, as far as they were legible, are "Allah is merciful," &c.

Finding such success during the first day's excavation, I increased the number of excavators from twenty to seventy, and in the three days I was at Brahminabad I excavated three distinct houses, two on one side, one on the other side of a street fronting the principal bazar. A ground-plan of the excavation is given: it has no pretensions to great accuracy, but is generally correct;—many of the measurements were taken under a burning sun in the month of March, and others by torch-light. I also give a rough sketch of the front elevation of two of the houses. In reference to the ground-plan, it may be observed that there are several of the rooms without any door or entrance. This I can only explain by stating that some of the walls were found four, five, and six feet in height, and above the steps of the doorways, while others were found only a few inches above their foundation, and consequently below the doorways.

Again, it might appear strange, to a person not acquainted with Hindoo habits and customs, to find the bones of camels and cattle inside a house; but those who have lived in India will in that fact immediately recognise a custom to be seen in every Hindoo or Mussulman city of the present day.

"The walls of the excavated houses," says Mr. Richardson, in his notes on Brahminabad, "are well and substantially built,—here again showing the superiority of the men of old to those of the present day. The walls are all true, and at right angles to each other, as if built with the plumb and line, and not running in and out, without regard to symmetry, as we see buildings now-a-days in Sind. The walls are from a foot and a half to three feet thick, and no chunam or lime is used in their construction,—nothing but common mud; the floors appear to have been tiled, and the whole building built upon a raised platform, about six or eight feet above the common level. Small as these remains are, they are quite enough to show that the city was well and substantially built;—so much so that I am convinced that nothing but the hand of God could have caused such an overthrow. The ruin of ancient Babylon is not more complete."

I was at first of opinion that Brahminabad had been destroyed by an invading army, who had pillaged the city and slain the inhabitants, and

that time and decay had made it a heap of ruins. Old Buddeena, in Lower Sind, is an instance of this kind: there you see heaps of ruins not unlike those of Brahminabad, but in the midst of the ruins you also see several buildings, such as mosques and temples, whose walls were too strong for the hand of man to overthrow, and upon whose strength time and slow decay alone make any impression. At Brahminabad the ruin of the city seems to have been complete, and, with the exception of the fragment of the tower before described, nothing appears to have escaped utter destruction. This fact, added to the number of persons whose bones were found inside the houses, together with the quantities of coins and valuables that are to this day in Brahminabad, shook my belief that an invading army had destroyed the city.

Nor do I believe that the city was destroyed by fire. The walls had not the appearance of a conflagration. The many delicate articles everywhere to be found in Brahminabad, in a general conflagration of the city, must have been consumed: the glass, for instance, would have been fused; the bones would not have been in existence; and the delicate ornaments of the women would all have been destroyed, or borne the marks of fire; whereas nothing of the kind is discernible. The marks of fire were alone found on a few cooking-pots, and charcoal was also discovered near the flooring of the rooms, not in any great quantity, but as much as it might be expected the occupants of such houses would be likely to have for cooking purposes. The charcoal was as fresh as if made yesterday.

Mr. Richardson on this point observes:—"We found no remains of wood, which might have been used in the construction of the buildings; and, save on the floors, and there only in small quantities, no charcoal, or remains of burnt wood; so we may fairly conclude the city was not burnt. Neither do the old walls we have excavated bear the evidence of having been under the action of fire. A few old iron nails were found, but quite decomposed, retaining nothing but the form of a large spike nail. The almost entire absence of chunam seems strange, it being so generally largely used by Natives in the construction of their more substantial buildings. There is, however, no limestone to be found within forty miles of the place, and this may account for the want of it."

Under all these circumstances, I think it highly probable that the popular account that Brahminabad was destroyed by an earthquake is true. It must have been some such convulsion of nature to have effected the complete and utter destruction of a city so strongly built as Brahminabad; and I further think it probable that the same convulsion that

shook the city to its very foundation changed the course of the river which once without doubt washed the city walls.

Mr. Richardson gives three good reasons for supposing the city to have been destroyed by an earthquake,—they quite coincide with the opinion I have given above; but as Mr. Richardson is a very keen observer, and as his account is graphically expressed, I give it without fear of tiring my reader with a repetition. He says "That the city was destroyed by some terrible convulsion of nature is, I think, sufficiently evident,—

"1*st*.—Because the destruction is too complete to have been the work of time. A place so substantially built would in all probability have had some few buildings in a tolerable state of preservation; and also from the human remains found in one of the buildings which were excavated. These remains were found in the corners of the rooms. The wretched, terror-stricken inhabitants, finding their houses falling about them, like any other animal, crouched in the corner, and the falling material buried them. These remains (merely bones) were in a very decomposed state, —so soft as to be easily crushed to dust in the fingers; we were not able to get any entire bones. It is not probable these bodies were regularly buried in the places we found them: had they been so, the remains in all probability would have been found in a recumbent position, and not all crushed in a heap, as they appear now. I picked out one brick which entered corner-ways into a skull, and which, when taken out, had a portion of the bone adhering to it, but it was so fragile that I fear it cannot be preserved.

"2*nd*.—Had the city been destroyed by an invading army, the destruction would hardly have been so complete: had twenty barrels of powder been placed under each individual building, the ruin could hardly have been more perfect; besides, whatever mischief the soldiery of a conquering army might have committed on buildings and other property, they would surely have carried off coins and other valuables, which are now found in infinite numbers on the surface, but, generally speaking, so decomposed, from exposure to the elements, that the legends are obliterated. However, a careful and diligent search might be successful in procuring more perfect specimens than those yet seen, and might throw some light on the history of the city, &c. &c.

"3*rd*.—Had the city been regularly deserted, the inhabitants would surely have carried their valuables with them,—money in particular, and ornaments. The place must have been inhabited chiefly by Hindoos, as its old name, Brahminabad, would imply; and unless the Hindoos of former days were a very different people from the present race, and

supposing they had had time and opportunity, they would have carried off all their property, even to the last pie."

I do not think that any objection to the supposition that Brahminabad was destroyed by an earthquake can be founded on the fact that a large portion of the tower has remained standing so long after the city itself had been deserted. It may owe its partial preservation to its superior size and solidity, and the fragment which has been standing within the memory of the present inhabitants is evidently but a very small portion of the original edifice.

In the time of the Kaloras, so much remained that the reigning prince ordered the demolition of the steps leading to the top, for the purpose of frustrating the designs of robbers, who used the tower as a place of observation, from which to watch travellers as a preliminary to plundering them. A large portion of the tower, without the steps, was standing till about thirty-five years ago, when it fell, and has since remained in much the same state as it is now—a mere fragment.

Besides Brahminabad, there are the remains of several other cities on or near the supposed ancient course of the river Indus, showing that when that stream flowed by Omercote into the Gulf of Kutch, this older valley of the Indus was a fertile and populous country.

There is the ancient city of Alore, near Roree. Of his Highness Meer Ali Moorad's territory, which next intervenes, little is known; but directly you re-enter British territory, the remains of antiquities again appear. Lieutenant Jameson in a recent letter writes,—"I paid a visit to an ancient city in the Nowshera Purgunna, but there was nothing to discover. Ruins there are none, and the only thing that betrays former civilization is the vast quantity of old bricks with which the ground is strewed in every direction. There are one or two other places in the Mora Purgunna (immediately south of Nowshera), and from their uniform appearance and situation they must have formed a line of cities or towns on or near the banks of the Indus in a former dynasty, when the course of the river lay near them."

South, again, of these localities is Brahminabad, and further south, between Kippra and Omercote; I have heard of other ruins, and the remains of cities; and again, near the borders of the Runn of Kutch, are the ruins of Old Buddeena. Besides these there may be others, as this part of the country is little known.*

Another striking feature in this valley is, that along its whole length

* The ruins of Shahkapoor, in the Shahbunder district, are midway between Buddeena and the present course of the Indus, and on a branch of the Pinyaree rather than of the Narra. Lieutenant Phillips' account of Shahkapoor was forwarded to the Bombay Branch of the Royal Asiatic Society in May 1853.

# Inscriptions.

*On the octagonal Talisman in old Cufic.*

اَللّٰهُ وَعَلِيٌّ لَوْ عَزَمَ هُوَّ وَاحِدٌ

*God and Ali, if they wish any thing, it is the same as an order.*

لَا هُوَ العَلِيَ اِلَّا وَ هُوَ عظيمًا بِاللّٰهِ

*Ali is not, but by the aid of God he becomes great.*

مَا يَحْفَظُ بِاللّٰهِ وكَبَّرَ حَقًّا لَا يُوْجَدُ

*Whatever is protested by God, a greater than that in truth cannot be found.*

بَايْدِ اللّٰهُ وحا بِاَمْرٍ طَارٍ يَجِدَهُ

*By the assistance of God (rest of the line not understood.)*

اَللّٰهُ مَلِكٌ وَعَلِيٌّ وَلَا اِلٰهَ اِلَّا اللّٰهُ الْجَبَّارُ

*God is the King and Ali is (——) there is no God but the Lord the powerful.*

لَهُمَا الْكَلَامُ الْمُغْفَرَ اِلَّا اَمَرَ مَا هَنَا

*For them is the (——) word as a boast (and there is none) except the order that saves us.*

Appended are also the inscriptions which have been deciphered from some of the Seals and Coins.

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Inscriptions on the Seals.

یاخدا یامالك یاحافظ

Oh God! Oh Master! Oh Protector!

امام باقر

Imaum Bakur - a proper name.

पाराणा.

Vanrana or jia rana. — King.

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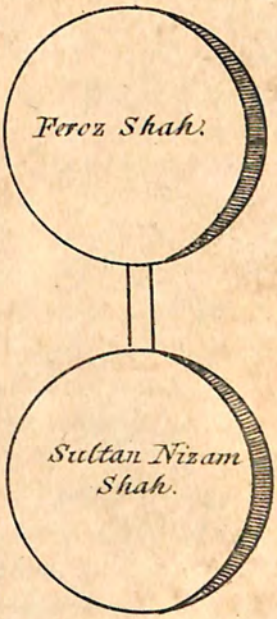
Another inscription supposed to be Arabic but unintelligible

There are several other inscriptions in characters which I have not been able to decipher.

*Inscriptions on the Coins.*

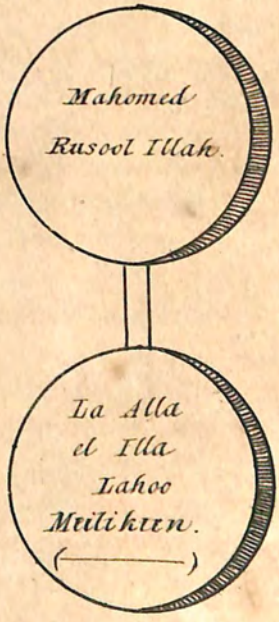
فیروز شاہ




سلطان نظام شاہ

*Mahomed the Prophet of God.*

محمد رسول اللہ




*There is no God but the Lord, and there is no Master to him.*

لا الہ الا اللہ لا ھو ملک

you can trace the dry bed of a large river. The main stream I take to have been the Eastern Narra,* which, flowing past Omercote and through Kutch, found an outlet into the Gulf of Kutch, or perhaps at Lukput, and in more modern times lost itself in that vast lagoon the Runn. This main stream threw off in its course several branches, the Dhoras or Poorans, the dry beds of which are clearly defined traversing the country fifteen to twenty miles west of the main stream, but parallel to it.

Lieutenant Lambert, writing from Mehrab-ke-Gote, near Wunga-ke-Bazar, on the borders of the Runn of Kutch, says: "I have just seen the Pooran; it is a splendid clear river bed, as large and distinct, and nearly as deep, as the Fullailee, and the country about contains the finest land, all waste. There is in its bed, where I have just been, a large pool about one hundred yards across each way, which is always filled with water, and contains fish of large size (30 or 40 lbs.), and according to the people here the pool is without bottom. Strange to say, there is no cultivation from it. There is an idea that because the Hindoos hold yearly fairs there it is unlucky to cultivate from it. The sandhills are about six or eight miles beyond, and the Narra runs along the foot of them; and I saw, in the short distance I went along the Pooran, two branches said to communicate with the Narra. I saw the Pooran again above Mora, as clear as here. It has not been traced yet between Mora and Meerpoor, but from Meerpoor downwards to Wunga-ke-Bazar, Lieutenant Piric has traced it, and it is clear the whole way."

I give these extracts because they throw some light on a very interesting country, of which very little is known, and I trust they may encourage further research in others. There can be little doubt that this valley was broader than the present valley of the Indus, that its soil was even more fertile, and its population, judging from the remains of its ancient cities, more numerous. There is not at the present day a city in Sind which, if overthrown by an earthquake to-morrow, would make such a show of ruins as Brahminabad.

In concluding this paper, I must add that I hope to revisit Brahminabad next cold season, and to continue the excavations, and that I shall be glad of the company of an antiquary, who is inclined to join my camp, and to dig among the ruins of the SIND POMPEII.

* A great public work is now in progress, at an estimated cost of about Rs. 5,00,000, under the superintendence of Lieutenant Fife, of the Bombay Engineers, to restore a permanent stream of water to the Eastern Narra, by cutting a supply channel of nearly eleven miles in length at a little above Roree, so as to connect the Indus with the Narra. This, and other works it is in contemplation to carry out on the Narra, will have the effect of restoring fertility to the whole of this valley, from Roree, past Kippra and Omercote, to Lukput.

## ART. IV.—*Parting Visit to the Sahyádri Caves.* By the Reverend J. STEVENSON, D.D., President.

Presented 20th April 1854.

IN a journey to and from Ahmednuggur, which I had lately occasion to undertake, I embraced the opportunity of visiting the Caves at Karle*n* and Junir. The advance of the season, with other circumstances, prevented my including Násik, as I first intended, though there were no very important doubts there to be solved.

The object I had in view was to ascertain how far the lithographed copies of the Cave-Inscriptions, lately published by our Society, were to be depended on; and whether the changes I had ventured in some instances to make were warranted by the originals engraved on the rocks.

After a careful examination and comparison, I may venture to say that Mr. Brett's fac-similes are in general very exact, and that the reduction of them in the Society's Journal is on the whole faithfully executed; so much so, that no one who is acquainted with the Cave Alphabet need experience any difficulty in making a transcript of the letters that remain uninjured, into the Devanágarí. As, however, few of the inscriptions are entirely perfect, nearly all having suffered more or less from the ravages of time, it is not an easy task to present them as they originally stood. Cracks in the stones are mistaken for parts of letters, and parts of letters widened by the decay of the rock are apt to be passed over altogether, as mere blemishes in the stone. In many instances, after the copyist has done his best, doubts will still remain; yet, as far as I can judge, Mr. Brett has exercised a just discrimination in most cases of this kind.

There are, however, one or two exceptions to this general eulogy, which must now engage our attention.

In the first Karle*n* inscription we have the name of a monarch, whose son executed one of the pillars outside the entrance of the Great Cave. According to our lithograph the name of the sovereign in question must be read *Goti*. Depending on other authorities, I read the name *Bhoti*, and for reasons given (page 3 of the July No. of 1853) identified

this sovereign with the Deva-Bhuti of the Puráns. The point to be decided then was, whether the first consonant should be read ग *(g)* or भ *(bh)*. In the cave character ग is a semi-circle, with its convexity turned upwards, and भ is the vertical segment of a bottle whose neck is about three-fourths the length of its body. On examination, then, I found the neck of the letter in question well expressed, and quite distinct, and as long in proportion to the whole letter as that of the भ in the third syllable from the end, about which all are agreed, though this latter is altogether a larger letter than the former. The reading I adopted, then, is the correct one, and the lithograph requires here to be amended.

In reference to the other parts of this inscription, I would notice that the tail of त—the last consonant in *Bhoti*—is too long in the lithographs, and resembles त. I was wrong in reading the fifteenth and sixteenth syllables नाक. The word is decidedly णक, though, as previously noticed, the meaning is the same.

In No. V., marked in the lithograph, by a confusion of figures, No. III., there is a mistake at the beginning of the second line, where the first syllable on the stone is plainly भि, as formerly conjectured. I should notice here, also, that No. III. of the text is No. IV. of the lithograph, and, again, No. IV. of the former No. V. of the latter.

In reference to No. X., the conjecture I made regarding its position is incorrect. It is over a blocked-up door, to the left of the entrance of the Great Cave. This door must have led into the space behind the pillars on that side, which in ancient times may have been used as a refectory, though now made into a house, by a rude wall of stone and mud, for Gosains.

No. XV. is on the fifth pillar from the door on the right,—on the spectator's left while entering.

The series of Caves at Karle*n* are the Great Temple, containing the Dagoba, in which cave and on front of which most of the inscriptions are engraved; two monastery caves to the right, the first of three stories, and containing no inscriptions; a second monastery cave on the same side, of two stories, in the upper part of which is inscription No. XVIII.; and in addition four other small excavations or monkish cells, to the left of the Great Cave, in the furthest of which, fronting the east, there is a short inscription not taken by Mr. Brett, which I read, though with some doubt of the second word, सिधं भगवतस बुधरखितस देय धम; and which may be translated, "To the Perfect One. A religious assignation to the Lord (Buddha), by Buddharakshita."

At Junir, the comparison of the lithographs with the original rock inscriptions was on the whole favourable to their accuracy.

A few remarks, though not on points of first importance, however, may be made.

In No. VII., the transcript of the two last letters into णीयं is wrong. The lithograph is not good, and even the original is anomalous; but I think it should be read खायं, so as to make the last word आखायं, that is आगत, "*come*," as I conjectured ought to be the case, though I did not conceive myself warranted to make the change.

In No. XII., the Vigabh or veranda there mentioned is no part of the temple, but a low range of caves to the left of it.

In No. XIX., the transcript of the name of the village should be महवोजे. Some other points of inferior importance I also noticed, which cannot well be explained in words, and therefore I abstain from further remarks.

I examined also the inscription at the top of the Náná Ghát. In reference to it, my conjectures have proved unfortunate. The fourth syllable of the fourth line is not च, but भा, and the last letter, though broken, was certainly म, as Colonel Sykes gives it. I rather think that the preceding letter also is म, and that what appears a part of स is but a crack in the stone. The name Asoka, then, could not have formed a part of the inscription; and I incline now to think that Sántin must be the proper name of the sovereign who formed the cave; but whether he can be identified under this name with Asoka, or any other sovereign of that period, I cannot determine. The Sánti of the Puráns is too early for us, and I have not been able to ascertain what is the Hindu name of the Sánti of the Jains.

As I may not again have an opportunity of addressing the Society, I embrace the present occasion to express my gratitude to the members for the favourable reception they have given to my papers on Indian antiquities. Without the advantages of the Library of the Society, however; the stimulus afforded by the success of my fellow-labourers in this and in other departments, especially the geological; and the advantage of such a medium of communication with the public as the Society's Journal furnishes, it is not likely that my attention would have been directed to such subjects at all, or, if directed, that I should have been able to persevere in their successful prosecution.

ART. V.—*Notes on Freshwater Infusoria in the Island of Bombay.—No.* 1, *Organisation.* By H. J. CARTER, Esq., Assistant Surgeon H. C. S., Bombay.

Read February, 1856.

IT may appear, at first, trifling to engage in the study of beings too small to be viewed by the unassisted eye; but it soon ceases to do so, when we learn that the highest organic developments are made up of such beings; that every organ has its peculiar being, which differs as much in form and functions as the soldiers of different regiments; and, therefore, that to possess a practical knowledge of an animal or vegetable, we should be acquainted with the several kinds of beings of which it is composed, just as much as a general is with the dress and functions of the different soldiers of an army. What should we say of a general who commenced a campaign with no other knowledge of his soldiers than that one group were artillery, another cavalry, a third infantry, &c.; and yet the physician sets out on his campaign against disease with the little army of which his patient's body is composed, equally ignorant of the wants, habits, forms, and functions of the beings peculiar to the different organs, as such a general would be of the peculiar capabilities of the soldiers belonging to his different regiments. A parity of reasoning serves for both cases, and therefore it is plain, that however much we may be inclined to restrict our pursuit of knowledge in this respect with regard to animals and vegetables, it is not our interest to curtail it in the least with regard to man; while, on the other hand, we find that we cannot confine these investigations to man alone, inasmuch as it is impossible to carry them on successfully in man without constant reference to the simplest forms of organic life. Hence it does not appear, as at first, trifling to engage in the study of beings which are too small to be seen by the naked eye; especially when by such a study we may hope to add that knowledge to our present acquaintance with the human frame which will enable the physician to practise his profession with certainty instead of empyricism, and thus

confer on mankind the greatest of all blessings that scientific research can aspire to obtain.

Influenced by these views, I have not hesitated for some time past, when circumstances would admit, to give my attention to the study of the Infusoria and Freshwater Algæ of the island of Bombay, which being the same, generally, as those of Europe, have not occupied me much in specific description, while they have left me comparatively uninterrupted in their structural and physiological observation. How much has been gained by the latter the following summary of my "Notes" will show.

I shall commence with the Freshwater Rhizopoda, *Astasia*, and *Euglena;* but before proceeding to remark on them separately, I would premise some observations on the organisation generally of Infusoria, and these will be arranged under the following heads :—

*Pellicula*, or skin.
*Diaphane*, or transparent moving matter.
*Sarcode*, or abdominal mucus.
*Moleculæ*, or minute grains.
*Granules*, or large grains.
*Digestive Globules*, or spherical spaces which enclose the food.
*Spherical Cells*, or biliary organisms. (?)
*Vesicula*, or "Contracting Vesicle."
*Nucleus.*
*Ovules*, or embryonic cells.
*Spermatozoids.* (?)
*Impregnation.*
*Development of Ovule.*

*Pellicula.*—This term has been proposed by Mohl for the consolidated surface of material which has no distinct enclosing membrane ; * Dujardin, in allusion to the tegumentary covering of *Amœba*, &c. likens it to the film which occurs over "flour-paste or glue allowed to cool in the air"; † and the same view of it will be taken here. It is at first inseparable and undistinguishable from the tissue which lies beneath it, yielding in every way to the form which the latter assumes. As, however, *Amœba* progresses in development, and its activity begins to diminish, the pellicula appears to thicken and harden, although it still retains great tenacity ; and thus the expansions of the subjacent tissue

* Mohl on the Structure of Chlorophyll.—Ann. & Mag. Nat. Hist. p. 325, vol. xv. foot-note.—May 1855.

† Hist. Nat. des Zoophytes Infusoires, p. 29, *et seq.*

are seen to burst through it in much the same manner as the end of a stream of lead bursts through its pellicle. Finally, when all activity ceases, and the *Amœba* becomes stationary (by fixing itself to some neighbouring object through a pedicular prolongation of the pellicula), a new layer of the latter is formed below the old one, and thus the capsule is formed, and the pellicula replaced on the body of the *Amœba*, until the latter becomes firmly encysted. To what part of the body of the *Amœba* the pedicular process corresponds I am ignorant; but it is interesting to see that in *Euglena*, where a similar process takes place, it is the anterior extremity which is next the pedicle. Many freshwater Rhizopoda secrete a testaceous covering, which increases in size with the animal; but the fleshy part of the body, being for the most part free, is of course still covered with pellicula. The pellicula forms the surface covering of *Astasia* and *Euglena*;* as well as that of all the *holo- poly- diplo-* and *mono-* ciliated flexible animalcules and zoospores. Here too, probably, the cilia themselves are also covered with it, though secreted by subjacent organs, analogous perhaps to those which secrete the hairs on the bodies of higher animals,—a supposition that would appear ridiculous did we not find such a correspondence between the vital processes of the highest and lowest developments as to induce us to think the one are but a repetition of the other on a smaller scale; that is to say, effected by similar agents, of corresponding minuteness, conducted on the same principle. Taking the view above given of the pellicula, we must regard it as a structureless product, which hardens after secretion. May we not infer that there is a layer below, specially organised for its formation?

*Diaphane.*—By this name I would designate the moving substance on which the pellicula rests. In *Amœba*, whose primary figure is spherical, it has the power of changing this into an almost unlimited number of secondary forms, most of which, being attended with root-shaped prolongations, justly entitles this infusorium to a place among the Rhizopoda. That the diaphane is structureless and transparent, so far as our microscopic powers extend, may be seen by the travelling of some kinds of *Amœba* across the field of the microscope, in which the coating

* Although *Astasia* and *Euglena* are here mentioned together, it seems that, in classification, one should be on the animal, and the other on the vegetable side of *Amœba*; for *Astasia* possesses a mouth and complicated buccal apparatus for biting off and taking in food, while *Euglena* appears to have no mouth, and to be nourished by endosmosis. The half-developed cilium, too, in *Euglena*, compared with the strong prehensile organ which it is in *Astasia*, with many other points which will be mentioned hereafter, allies the former as much more to the zoospore or gonidium of the Algæ, as the reverse does the latter to the higher infusoria.

of the diaphane, though broader all round than the diameter of the turbid mass of contents in the centre, only now and then, when the light is favourable, comes into view. The radii in *Actinophrys* are wholly devoid of turbid material, except towards the base; and the advancing border of the *Amœbæ* generally is always transparent. But whether granules are mixed with it or not, the diaphane by itself, that is the contracting material, in the present state of our microscopic powers, must be characterised by transparency and motion, without apparent structure. It has the same appearance and polymorphic power in *Difflugia*, *Euglypha*, and *Arcella*, as in *Amœba*; but in *Astasia* and *Euglena*, though still possessing great latitude in this respect, it can put forth no prolongations, and, consequently, the primary forms of these families are never entirely lost. This latitude is still more limited in *Oxytricha*, *Plœsconia*, *Paramecium*, &c., though in many infusoria of this class it has still the power of temporarily producing considerable alteration in shape. It might be stated that the diaphane cannot be demonstrated in these animalcules; but the great power of motion of their tegumentary covering, combined with transparency, warrants the use of the term here just as much as in Rhizopoda, where it is only more striking, because, for want of cilia, the animalcule is compelled to put it forth in delicate expansions and prolongations, in progression, and for the capture of its food; indeed these are the two great modes in which all vital movements are effected.

Some might think, from what has been stated, that there is no difference originally between the pellicula and diaphane, and that the latter passes into the former when the animalcule becomes encysted. But neither appears to be the case; for if we watch *Amœba* or *Euglena* undergoing this process, the activity and accompanying polymorphism of the diaphane is diminished only by the thickening and consolidation of the cyst, until the latter is fully formed, when it ceases altogether. Subsequently, however, in *Euglena*, when this animalcule becomes temporarily encysted, the diaphane separates itself from the last layer of pellicula which completes the cyst, and thus the *Euglena* becomes free within it; after which it will force off the constricted peduncle of attachment from the object to which the cyst may have been fixed, and, projecting its cilium through the broken part, swim about for some time, until (perhaps by increase of size) the cyst is altogether burst, and its liberation restored. Yet it might still be observed, that this is no proof of the cyst and diaphane having been originally distinct structures,—the diaphane may have been re-formed; in which case I can only refer to what I have questioned respecting the origin of the pellicula, and add that

what takes place generally in the higher organisms appears to me to be applicable to the lower ones. Certainly we do not find one structure erected by the organism of another in the former, but the production of each structure dependent on the presence of its proper organism *ab initio;* that is, that the structure does not appear before it is accompanied by the full developed form of the cell or organism which produces it. I do not question that, under the laws of vitality, one organism may occasionally take on the excretory or secreting functions of another, nor that, from a common stock, all organisms, in obedience to the same laws, may be adapted to that which is particularly required of them; but that when once a being is fully developed, each organ of which it may be composed has its peculiar organism, and that organism its peculiar duties, which, except in unusual instances, are the only ones that it is capable of performing. That the diaphane, therefore, should pass into the pellicula, or the pellicula be secreted by the diaphane, seems untenable.

*Sarcode.*—This name was proposed by Dujardin for the "glutinous subtance of the interior" of infusoria;* and we shall here understand it as applicable solely to what, in other words, might be termed the "abdominal mucus." The sarcode occupies the centre, while the diaphane and pellicula form the circumferential layers of infusoria; besides this, it is the seat of the "granules" and other organs of the interior, and appears to receive the food directly into its substance. From the greater latitude of the particles which are situated towards the centre, that portion may be inferred to be of less density than the rest; and sometimes, when the animalcule is rendered spherical by aqueous distension, there appears to be an actual cavity here; but as I am not certain about the real situation of the water under these circumstances, I shall return to this point again by and by. In the Rhizopoda generally, the sarcode appears to have no external communication, and hence the food must pass into it directly through the diaphane; but in most of the other infusoria it communicates with the surrounding medium by one orifice at least. The same kind of substance occupies a good portion, if not the whole, of the internal or abdominal cavity of *Astasia* and *Euglena, Vorticella, Paramecium,* and the infusoria of this class. When death is about to take place, it comes forth from *Vorticella, Paramecium,* &c., in round, transparent, structureless expansions; and even during life in *Stentor* a portion may be made, by pressure, to issue through a rupture of the pellicula

* *Op. cit.* p. 35.

without any apparent injury to the animalcule.* *Otostoma*,† also, when under pressure, throws off portions of its sarcode through the anal orifice, containing a number of the "spherical cells," to be mentioned hereafter, with which it is charged in this kind of infusorium. As we shall presently find that the portions of food which are received into the midst of the sarcode are circulated round the abdominal cavity, it seems necessary to admit, also, that the sarcode is endowed with a power of motion, in which we cannot help seeing an analogy to that motion which exists in the alimentary canal of higher animals.

In *Euglena* the sarcode is separated from the diaphane by a layer of pointed, sigmoid fibres, arranged parallel to each other, so as to form in *Crumenula texta* (Duj.) a conical cell, which, as soon as the ovules have become developed, and the diaphane and other contents of the sarcode have died off, becomes transparent, but still retains its conical form until the resiliency of the fibres, now unrestrained by the diaphane and other soft parts, dehisce, and the ovules are set at liberty. May we not infer that the siliceous frustule of *Navicula* is similarly situated to this fibrous layer, and that it also derives its power of motion from an external coating of diaphane? That there is a gelatinous layer external to the frustule probably in all *Diatomeæ*, may frequently be seen, although it may not be always endowed with mobility. In a species of *Palmellea* like *Glœocapsa granosa* Kg.‡ which I have had under observation, the transparent external covering ("envelope cell," of Cohn) not only at one period presents an actinophorous form, but also moves about under this condition, bearing the green elliptical cell within (singly, or divided into two or four, &c. as the case may be), whose form depends upon the presence of a more or less firm coat, that corresponds in position and office to the spiral coat in *Euglena* and silicious frustule in *Navicula*, viz. in supporting the contents of the sarcode and chlorophyll-bearing protoplasm, and in sustaining their form in all these organisms respectively. In *Oscillaria (princeps Kg. mihi)* too, although, like *Navicula*, the presence of a layer of substance endowed with motion round the cells cannot be seen, yet, when we observe the whole chain of a fragment moving slowly backwards and forwards within its sheath, and even extending beyond it, so as to force out the loosened cells at either end (probably for the formation of new filaments), we can come to no other conclusion, that I see, than that each cell, which corresponds in office

* Ehrenberg, *ap.* Dujard. *op. cit.* p. 34, foot-note. It is the same with *Nassula*. Au.

† Ann. & Mag. Nat. Hist. pl. ix. figs. 6—8, vol. xvii.—1856.

‡ *Hæmatococcus granosus*. Hassall, pl. 81, fig. 6. Brit. Freshwater Algæ. But with cells scattered, not continuous.

to the frustule in *Navicula*, &c., is surrounded by a transparent, gelatinous substance, endowed with motion, and that, *en masse*, they perform this act. In none of these instances does this envelope, if existing in *Navicula*, as well as the rest, present any change on the addition of iodine but a yellow tinge, even when assisted by sulphuric acid; and it therefore appears to be entitled just as much to the term of diaphane in *Navicula* (if present), *Glœocapsa granosa*, (?) and *Oscillaria*, as in the infusoria. In *Closterium* there are no signs of an organ of this kind externally, except at the extremities, where it may be an extruded part of the ciliated protoplasm within; for *C. lunula*, as Morren has stated, can fix itself by one end, and partially rotate upon that end; while in *Spirogyra* this much extrusion of the protoplasm is not permitted, and the cell is here closed after the manner of vegetable cells generally. What further strengthens the view that there is in some Diatomeæ *(ex. gr. Navicula et Nitzschia)* a layer corresponding to diaphane on the surface is, that there is some prehensile and transporting organ here, which undoubtedly has the power of seizing particles that come in contact with it, and conveying them partially or wholly backwards and forwards from one extremity of the frustule to the other, or of retaining them on any part of it stationarily.

*Moleculæ.*—We will apply this term to the minute, colourless granules with which the sarcode is charged. They differ in size, and are the first bodies that appear in it; but whether they be of different kinds, have any particular office, or undergo any further development, I am at present ignorant. *Amœba*, *Astasia*, and *Euglena*, in the earlier part of their existence, respectively seem to contain nothing else but this molecular sarcode, the nucleus, and contracting vesicle; afterwards the "granules" appear, and last of all the ovules, both of which are developed in the sarcode amongst the moleculæ. By the time the ovules have become fully formed, the sarcode and its moleculæ have died off, or disappeared.

*Granules.*—This name is intended for certain large granules, which make their appearance among the moleculæ, and are circulated round the abdominal cavity in the manner of the digestive globules and particles of food. They are of different sizes, but chiefly characterised by being much larger than the moleculæ, few in number, of a circular, elliptical, elongated, sub-round, or irregular shape, with thick dark edges, apparently produced by obstruction to the passage of light,—colourless, or of a yellowish green tint. When large, and with no other granular matters present but the moleculæ, they form a striking feature in the interior of *Amœba*, *Vorticella*, *Oxytricha*, *Paramecium aurelia*, &c.; but at times

they are so insignificant in size as to be undistinguishable from the moleculæ, even if present at all. That they are not ovules may be satisfactorily seen when both are together; the dark, thick, and frequently irregular edges and colourless state of the former, contrasting strongly with the thin, circular margin and faint-yellow tint of the latter. They appear to increase in size and number with the age of the infusorium, and, when fully developed, to remain unaltered in size, though apparently somewhat shrivelled in form, until their dissolution. On one occasion, while watching the metamorphosis of an *Oxytricha* (similar to, but not the same as that described by M. Jules Haime,* and of which I hope to give a detailed account hereafter), these granules, during the formation of the globular cell within the body, which enclosed the materials from which the *Plæsconia* was ultimately developed, became congregated together at the posterior extremity of the *Oxytricha*, and remained there in a roundish mass, shut out from the cell, until the latter burst for the liberation of the *Plæsconia*, when, with the deciduous coverings, they passed into dissolution. Of the nature of their office I am ignorant, but they are sufficiently remarkable and constant to demand particular notice.

In the development of the sponge-cell, a similar set of large granules make their appearance at a very early period, and increase in number and size until they form as remarkable a feature as those above noticed. At this time they are about $\frac{1}{1000}$ of an inch in diameter, of an elliptical shape, and of a light amber colour, by transmitted light; they are the colour-bearing granules or cells of *Spongilla*, and give the colour of chlorophyll to this organism when it becomes green.

Such granules would appear to be present in the earliest forms of *Amœba;* since they may be seen in *mono-* and *diplo-*ciliated monads, which, on losing these appendages, become polymorphic, and assume all the characters of *Amœba* in a young state. Here they not only resemble the granules of the sponge-cell, but at the same time appear to be of the same kind as those above described. Neither is it uncommon to see polymorphic cells, precisely like *Amœba*, bearing granules coloured like those of the sponge-cell; but the resemblance between the two organisms is so great, when the latter is free, that it is impossible to say which is which: however, they are greenish yellow, and elliptical, elongate in the foot of *Difflugia proteiformis* (Ehr.), which cannot be confounded with the cell of *Spongilla*. That these granules are not ovules in the sponge-cell, any more than in infusoria, their colour alone is sufficient to determine.

* Ann. des Sec. Nat., T. xix. p. 109, Zool.—1853.

*Digestive Globules.*—We shall use this term for spherical spaces of the sarcode, which are filled with water, and generally contain more or less food. They are formed in *Vorticella* and *Paramecium* in the following way, viz. as the particles of nutritive matter are drawn into the vortex of the buccal cavity, by the cilia which are disposed around its orifice for this purpose, they are forced down, with a certain amount of water, into the sarcode at the end of it, where they at first form a pouch-like dilatation, which sooner or later becomes constricted close to the buccal cavity, and, having been thus separated from it, passes off in spherical forms into the midst of the sarcode. The formation of one globule is soon followed by that of another; and so on successively the food, with a large quantity of water, is taken into the abdomen; sometimes the globule appears to contain nothing but water. When in the sarcode, it is continually undergoing circulation round the abdominal cavity, until the whole of its contents are digested, and resolved into a fluid, or until their nutrient parts are abstracted; the remainder then, still in a globular form, if there be sufficient water left to sustain this, is cast off through the anal orifice, as it arrives opposite this point during rotation. Frequently, however, nothing but the crude ingesta remain; for as soon as the globule begins to be circulated, the watery contents begin to be absorbed,—hence some particles of food are almost always present, without any globule round them; added to which, in many instances bodies pass directly into the sarcode without any globule at all. I cannot think, with most others, that there is any intestinal canal in the abdominal cavity, because the digestive globules and other particles of food are constantly undergoing circulation round the *whole* of its interior. In *Vorticella*, particles of food may occasionally be seen to circulate throughout, and accumulate, in every corner of its interior, particularly those which do not happen to be enclosed in globules. Moreover, the intimate resemblance which exists between the alimentary organs of higher infusoria, viz. *Nassula*, *Otostoma*, &c., and those of the binocular and so-called blind *Planariæ*,—in the distance of the mouth from the anterior extremity, the presence of a buccal apparatus, and a simple sac-like stomach in the latter, lined with a layer of mucous substance (sarcode?), charged with the "spherical cells" about to be described, is so great, that with such a simple gastric organ in an animal so closely allied to these infusoria as *Planaria*, I do not see what reason we have, in descending the scale, to expect a more complicated digesting apparatus; but, on the contrary, one still more simple, in which there would be no stomach at all;—a condition which appears to me to be common to all the infusoria that have come under my notice.

In the *Amœba*, for want, apparently, of a channel of communication with the exterior, the introduction of food seems to take place directly through the diaphane; and it is only now and then that the process by which the digestive globule is formed can be distinctly seen. Thus, on one occasion, where the particle about to be enclosed was a small *Amœba*, the latter, after struggling for some time, got under the former, when the large *Amœba* raised its diaphane in a dome-shaped cavity over the small one, and then, closing in below, after the manner of a sphincter, shut in the small *Amœba*, which, with a portion of water, immediately passed into the sarcode, under the form of a spherical digestive globule.* That the food is broken down by a digestive process in this way may be seen in the *Amœba*, where it frequently appears in all degrees of solution in the same individual; viz. from an opaque, crude mass, to a blue or brownish fluid, according to the colour which the material may assume under its altered condition. In *Astasia* digestive globules also appear, but here the food is taken in through a distinct mouth, while in *Euglena*, the absence of such vesicles would appear to indicate that its support is derived in a different way.

*Spherical Cells.*—These cells, to which I have just alluded, abound in the sarcode of *Otostoma*,† and apparently in many of Ehrenberg's allotreta. In *Otostoma* they are of different sizes, because they are in all stages of development; and, to keep up their numbers, without distending the animalcule, they must be continually undergoing rapid decay, as well as reproduction. The most remarkable feature in them is, that the largest, besides other granular bodies, contain several small cells, filled with a brownish yellow fluid, and these cells are also found free among the general group; but what their ultimate destination is, as they do not appear to grow larger, or to become reproductive, I am ignorant. In the *Planariæ* to which I have alluded, as well as in Rotifera, such cells nearly fill the stomach, and the large ones being more or less grouped together in the former, at the same time that they chiefly contain the yellow cells, gives the whole a sub-acinous or glandular appearance, very like the hepatic element surrounding the alimentary canal of some of the lower worms. It is also interesting to find here that each possesses a lash of cilia (about 50) projecting from one part of the cell, which, for some time after they are forced into the water through the anal orifice, or a rupture of the body, act by their whipping movements as imperfect locomotive organs, while, when these cells are fixed *in situ*, the same whipping movement must

* Ann. & Mag. Nat. Hist. vol. iv. p. 93.—1849.

† Idem, vol. xvii. pl. ix. fig. 6, *b*, *b*.

keep up a continued agitation of the gastric contents, which, if not conducted in a similar way in the infusoria, has its analogue there in the circulation of the digestive globules, and granular matters of the sarcode. Although ovules may occasionally issue together with these cells from *Otostoma*, &c. as from the *Planariæ*, yet the two can hardly be confounded; while in the *Planariæ* the peculiar character of the ovule not only distinguishes it, but by careful manipulation the whole generative apparatus may be exposed outside the stomach.

That these cells in *Planaria* and *Otostoma* are homologous organs can hardly be doubted, both from their general characters and their correspondence in position; but what their office may be is at present unknown. Occurring, however, as they do, in the stomach of *Planaria* and Rotifera, where there is no other analogue of the so-called biliary follicles of the lower worms,* and being almost identical in *Otostoma* and *Planaria*, they not only ally these two organisms, but, at the same time, appear to be the homologue of the biliary follicles in each.

I have never seen any cells of this kind in *Amœba*, unless the "granules" already described be their analogues. It appears evident that these both in *Amœba* and the sponge-cell are the same, and that they are the seat of the green colour in the latter. Are the green granules of the sponge-cell analogous to the parts or cells respectively which hold the colouring matter or endochrome in the *Diatomeæ*, *Closterium*, *Spirogyra*, *Cladophora*, &c. and (through the latter), to the "green disks" or peripheral layer of chlorophyll-bearing cellules in the internode of *Nitella*, and those which, scattered irregularly through its moving protoplasm, are circulated round the cell of *Serpicula verticillata*? If so, the chlorophyll-bearing parts of the protoplasm in vegetables may be the analogue of the liver in animals. In some Rotifera the spherical cells appear to bear bile as green as grass or chlorophyll,† while in others it is

* By this I do not mean to class the Planarians with the worms. Mr. C. Girard, who has followed out the "Embryonic Development of Planocera elliptica," would ally them to the Gasteropoda. "Researches upon Nemerteans and Planarians." 4to, Philadelphia, 1854.

† Since writing this, I have seen *Diglena catellina* (Ehr.) discharge the green matter from its alimentary canal, and retain nothing but the ordinarily coloured biliary cells; also *D. caudata* to have the whole of the soft tissues of its body coloured in this way, unless there be diverticulations of the stomach to this extent; so that I now begin to think this colour, which at first appeared persistent, to be adventitious, and gained from the *Euglenæ*, and, perhaps, chlorophyll-bearing protoplasm on which these species chiefly feed. Accidentally, perhaps, the bile may become green in any species of Rotifera, as in animals generally; and this appears to be the case with the endochrome of *Diatomeæ*.

yellow. The same diversity of colour occasionally manifests itself in the *Diatomeæ;* while in *Spirogyra* especially, the oil-globules and amylaceous deposits, which abound in abortive conjugation, are entirely confined to the green spiral-bands, thus corresponding, in one identically, and in the other transitionally, with the fat and sugar which are found in the liver of man; the colouring matter in all of course being, when present, a mere indication *cæt. par.* of the nature of the organ. How the colour-bearing cellulæ of the spherical cells are produced in *Otostoma* and *Planaria* I am ignorant; but in some Rotifera (*ex. gr. Brachionus Pala,* Ehr.) they present themselves at an early period in a circular or discoid group, attached to the cell-wall, and thus, with the absence of the nucleus, closely resemble a granulated state of that organ.

*Vesicula.*—I would propose this name for the "Contracting Vesicle," on account of the latter being a loose and inconvenient term in description. It is certainly the most striking organ of the infusoria, from its defined circular outline when distended, its hyaline aspect, and above all its sudden disappearance and gradual return at intervals, which gives it a pulsatory character, so like that of a heart, that at first we are inclined to conclude that it must be the representative of this organ in the infusoria. Spallanzani considered it a respiratory organ;* Ehrenberg the male organ of generation;† and Siebold a circulatory organ.‡ The following facts, however, would seem to show that it is neither of these, but an excretory organ, viz.:—

1*st.*—It is always seen either close to the pellicula, or close to the buccal cavity, and always stationary. Thus, in *Paramecium aurelia,* it is close to the surface, and although it of course passes out of view as the animalcule turns on its long axis, yet it always re-appears, after contraction, in the same place; while in *Vorticella* it is attached to the buccal cavity, and, being centrically situated, seldom passes out of view, except when it disappears under contraction, after which it also re-appears in the same place.

2*nd.*—In *Actinophrys Sol,*‖ and other *Amœbæ,* during the act of dilatation, the vesicula projects far above the level of the pellicula, even so much so as occasionally to form an elongated, transparent, mammilliform eminence, which, at the moment of contraction, subsides precisely like a blister of some soft tenaceous substance, that has just been pricked with a pin.

3*rd.*—Lastly, when we watch the contracting of the vesicula in a

* *Ap.* Dujardin, *op. cit.* pp. 103, 104. † Idem, pp. 105—108.
‡ *Ap.* Claparède, Ann. & Mag. Nat. Hist. vol. xv. p. 212.—1855.
‖ Idem, *loc. cit.* pl. viii. fig. 1.

recently encysted *Vorticella*, we observe that at the same moment that it contracts the buccal cavity becomes filled with fluid; and further, that this fluid disappears from the buccal cavity, and all trace of the latter with it, long before the vesicula reappears—thus proving at once, that the fluid comes from the vesicula and does not return to it, whatever may become of it afterwards.

The position of this organ, then, its manner of contracting, and the buccal cavity of encysted *Vorticella* becoming filled with fluid the moment it disappears (where we know it to be attached to the buccal cavity, and not to the pellicula), are almost conclusive of its excretory office. We have now to find out how this fluid is brought to the vesicula.

It will be remembered that there is a series of fusiform sinuses which surround each of the vesiculæ in *Paramecium aurelia*, and some other animalculæ of this class, on which Spallanzani made the important observation, that as they become empty the vesicula becomes filled.* This may be easily seen, as well as that they do not re-appear until some time after the vesicula has contracted. Thus we infer, that the fluid with which the vesicula is distended comes through the sinuses, but is not returned by them to the body of the *Paramecium*.

Now in some cases, faint hyaline or transparent lines may be seen to extend outwards† from each of these sinuses, and which lines, Eckhard has stated, "traverse the body in a stellate manner." Hence, when we add Eckhard's evidence (which I have been able to confirm in a way that will be presently described) to the observation of Spallanzani, and connect this with the facts already adduced in favour of the excretory office of the vesicula, it does not seem unreasonable to conclude that the whole together forms an excretory vascular system, in which the vesicula is the chief receptacle and organ of expulsion.

While watching *Paramecium aurelia*, I on several occasions not only observed that the vesiculæ were respectively surrounded by from seven to twelve pyriform sinuses of different sizes, and that lines extended outwards from them in the manner described by Eckhard; but I further observed that these lines were composed of a series of pyriform or fusiform sinuses, which diminished in size outwards; and frequently I could trace as many as three in succession, including the one next the vesicula. Hence, I am inclined to infer that this vascular system throughout is more or less composed of chains of such sinuses, and that all have more or less contractile power like that of the vesicula. Just

* Spall. *ap.* Dujard. *op. cit.* p. 103; Spall. Opus. phys. trad. franc. t. i. p. 248.

† Ann. & Mag. Nat. Hist. vol. xviii. p. 448.—1846.

preceding death, when *Paramecium aurelia* is compressed, and under other favourable circumstances, these sinuses run into continuous hyaline lines, and may not only be seen extending in a radiated, vascular form across the animalcule, but even branching out round the position of the vesicula, which, having now become permanently contracted, has thus caused them to become visible. They enter the lower or inner part of the organ, and at this point, therefore, are pushed inward as the vesicula becomes distended. Under the same circumstances, also, when the vesicula is slowly dilating and contracting, it may be seen to be attached to a small papilla on the surface, about twice the diameter of those which surmount the trichocysts,* and through which it probably empties itself. In *Otostoma* there appears to be a similar arrangement of vessels round each vesicula, and here also they seemed to me to be branched,—at least such was my impression after having watched this animalcule for a long time, in order to determine the point.

In *Amœba* and *Actinophrys* the vesicula is generally single, sometimes dual, and not unfrequently in larger *Amœba* in greater plurality. In *Euglypha* I have not been able to recognise it, but in *Arcella vulgaris* and *Difflugia proteiformis* it may be seen in great plurality, situated round the margin of that part of the animalcule which is within the test; and from their always reappearing, after contraction, in the same places respectively, we may infer that the situation of the vesicula in *Amœba* and *Actinophrys* also is fixed, though from their incessant polymorphism it appears to be continually varying in position. In *Paramecium*, and Ehrenberg's enterodela generally, the vesicula is either single or dual. When it exists in great plurality in any of these (*ex. gr. Chilodon cucullulus*, Ehr.), this appears to depend on accidental dilatations of the sinuses in connection with it. Thus, in the animalcule just mentioned, where the vesicula is single, and seems to be sub-terminal and lateral in its normal position, it is not uncommon to meet with a group in which every member presents a variable number of contracting vesicles, variably also and irregularly dispersed throughout

* These are narrow, fusiform cells, arranged perpendicularly, and at some little distance from each other, under the pellicula, where they thus form a layer all over the body, and each, according to Dr. Allman, contains a delicate, resilient thread, coiled up in its interior, which, just after the cells have been forcibly pressed out into the water, by crushing the animalcule, causes them to assume, for a second, a circular form, and then burst, through which the thread is set free, and, lying rigid on the glass, presents the form of an acicular crystal, terminated at each end by a pointed extremity, one of which, being more attenuated than the other, appears like an appendage. To these cells Dr. A. has given the name of "trichocysts." (Qy. Jl. Microscop. Sc. vol. iii. p. 177.—1855.)

the body, without one being in the true position of the vesicula. That the vesicula does make its appearance now and then may be inferred, as it perhaps may also be inferred that from over-irritability, or some such cause, it does not remain under dilatation long enough to receive the contents of the sinuses; and hence their accidental dilatation, and the appearance of a plurality of vesiculæ. That, also, the sinuses which are in the immediate vicinity of the vesicula do empty themselves into it may be easily seen, when both are present; and what takes place near it seems not unreasonable to infer may, through a concatenation of communication, take place from a distance. At the same time, the sinuses of this system in the sarcode of *Amœba* not only seem to burst into each other, and into the vesicula, but when the latter has contracted, another sinus, partially dilated, and situated near the border, may be seen to swell out and contract after the same fashion, before the reappearance of the vesicula. Then there is no knowing how many vesiculæ there may be in *Amœba;* while *Actinophrys Sol* (Ehr.) is surrounded by a periphral layer of vesicles, which, when fully dilated, appear to be all of the same size, to have the power of communicating with each other, and each individually, to contract and discharge its contents externally as occasion may require; though, generally, one only appears and disappears in the same place. In *Oxytricha* the vesicula is single or dual; but in *Plæsconia*, as far as my observation extends, always single. The vesicula is always single in *Vorticella*, where it is attached to the buccal cavity close to the anal orifice, as in *Rotifera* and *Colacium vesiculosum* (Ehr.). In one species of *Vorticella* there is a distinct pouch for these excretory orifices, about half-way up the buccal cavity. In *Colepina* the vesicula occupies the posterior extremity.

Its existence in *Astasia*, *Anisonema*, and *Euglena* can only be determined from inference. They all have a transparent vesicle situated close to the anterior extremity; and in *Astasia* we know that it is thus situated close to an external orifice, and the buccal cavity. In *Anisonema* it seems to alter in size and shape, as it does in some *Amœbæ*, without completely contracting; and also in *Astasia* it is at one time more defined and apparent than at another; but this may be owing to change of position in the entire animalcule. In *Polytoma Uvella* it is similarly situated, but double, and has been seen to contract by Schneider;* and in a small colourless animalcule, very much like a young *Astasia*, as well as in a minute species of *Chlamidomonas* (Ehr.), I have frequently seen this vesicle contract and dilate in the manner of the vesicula; so that

* Ann. & Mag. Nat. Hist. vol. xiv. p. 322.—1854.

there can be little doubt about the vesicle in the anterior extremity of *Astasia*, *Anisonema*, and *Euglena*, being the homologue of the vesicula, though in the latter the red body be appended to it; which, however, is not the case in the *Chlamidomonas* mentioned, where it is nearly in the middle of the body, and peripheral, while the vesicula is in the anterior extremity.

The quiescent state of the vesicula in *Astasia*, *Euglena*, &c. may be an approach to its disappearance altogether as a distinct organ, and therefore a step nearer to the vegetable kingdom. But Schneider, in allusion to this, quotes a passage from Cohn, in which the latter observes, that "internal pulsating spaces" have been discovered in "certain genera of Algæ"; on which Schneider justly remarks, that if they "occur in the swarm-cells of *Confervæ*, they certainly cease to be a characteristic of animal nature"*;—thus rendering useless another distinguishing point between animals and plants at this part of the organic kingdom, which after all, perhaps, may be found to have its homologue in the vacuoles of the vegetable protoplasm.

That the vesicula is a distinct organ, and not merely a space like the digestive globule, might be inferred from its always occurring in the same place in the same species; but in addition to this, the fact was on one occasion most satisfactorily demonstrated to me by its remaining pendent in a globular form to the buccal cavity of a *Vorticella*, when, by the decomposition of the sarcode, and evolution of a swarm of rapidly moving monadic particles, these two organs, with the cylindrical nucleus or gland, though still slightly adhering to each other, were so dissected out as to be nearly separate; and thus yielding in position from time to time, as they were struck by the little particles, their forms and relative positions respectively became particularly evident.

Although globular in shape, yet, as before stated, it is accompanied in *Paramecium aurelia* by a variable number of pyriform sinuses, which are arranged around it in a stellate form. In most of the other animalcules these are globular, and, under exhaustion of the animalcule from various causes, are frequently so distended, and thus so approximated, as to assume the appearance of an areolar structure, immediately in contact with the vesicula. Each globular sinus, however, would appear to be the proximel or largest of a concatenation of smaller ones, which diminish in size with their distance from the vesicula. The vesicula becomes doubled preparatory to fissiparation, and therefore appears

* *Loc. cit.* p. 330.

dual in *Vorticella*, and quadruple in *Paramecium*; and it is interesting to find that in the metamorphosis of the former into *Acineta* it frequently acquires a plurality similar to that which obtains in the Rhizopoda generally.*

Of the use of the vesicula, and its vascular system, we are at present ignorant, further than that its functions are excretory; and when we observe the quantity of water that is taken into the sarcode with the food, and try to account for its disappearance, it does not seem improbable that the vesicula and its vessels should be chiefly concerned in this office. Another service, however, which it performs, is to burst the spherical membranes of *Vorticella* and *Plæsconiæ* when they want to return to active life after having become encysted: this it effects by repeated distension, until the lacerated cyst gives way sufficiently for the animalcule to slip out. At these times, also, the animalcule is rendered so spherical by this distension that it is also evidently one way by which the infusoria might assume this form. Hence, in describing the sarcode, I have expressed a doubt whether the water in an *Amœba*, when distended in this manner, be in its centre or in the cavity of the vesicula. Certainly, when *Amœba* is in the form of a sphere, I never have been able to see the vesicula, while all the other elements of the cell have been perfectly plain; added to which, under these circumstances, a part of the cell wall is generally transparent, from the absence of the sarcode and its granules, which would be the case if the vesicula were the cause of the distension, since in *Amœba* it is attached to the pellicula, and therefore no sarcode exists immediately opposite this point.

Should it have any other uses, they are probably similar to those of the "Water Vascular System" of Rotifera, which in *Brachionus Pala*, one of the largest species of this class, consists of a corrugated sac when empty (like the bladder of mammalia), opening by a constricted neck into a heart-shaped cloaca close to the termination of the alimentary canal; and, when distended, presenting *(mihi)* a single vessel opening into its fundus, and then passing down through its side towards the neck, where it divides into two, which respectively run up laterally to the anterior extremity of the body, bearing in their course four monociliated (Huxley)† pyriform diverticula, and probably terminating, as in *Lacinularia*, partly in junction and partly in blind tubes. The vacuolar structure attached to these vessels may be analogous to the vacuolar structure connected with the vesicula in the infusoria, and it would be

* See particularly Stein's work on the Development of Infusoria.

† Qy. Jl. Microscop. Sc. vol. i. p. 7.

interesting to determine if the vacuoles in it occasionally diminish in size or disappear, or become dilated when from disease or approaching death the vesicula itself is unnaturally and permanently distended. Should the lateral vessels not terminate in *Brachionus Pala*, as above mentioned, then they must, as it appears in the other Rotifera, open into the vesicula close to its communication with the cloaca.

It might here be asked if all vacuolar dilatations of the sarcode belong to this excretory system of sinuses, that is excepting those made by the buccal cavity in the manner mentioned? Certainly, where there is a plurality of actively contracting vesicles, without the appearance of the vesicula, as in *Chilodon cucullulus*, we may, as before stated, attribute this to a kind of over-irritability or constrictive spasm of the vesicula, and, therefore, that these vesicles are accidental dilatations of the sinuses in connection with it; as we may set down the dropsical state of *Himantophorus Charon* (Ehr.), and other animalcules of the kind, to an opposite condition of this organ, viz. that in which it is unable to relieve itself of its contents: this I have often seen occur under my own eyes. But there is an intense vacuolar state of the sarcode which occasionally presents itself in *Amœba*, that makes it look like an areolar tissue composed of vesicles diminishing to a smallness that cannot be determined by the microscope,—such as is seen in the protoplasm of the vegetable cell: whether this still be a part of the vesicular system or not I am unable to decide.

Lastly, from the presence of the vesicula in *Spongilla*, and its being so constant in the Rhizopoda generally, and so numerous in *Arcella vulgaris*, it does not seem altogether unreasonable to infer that the streams of water which issue from the great canals of *Spongilla* are produced by the continued pouring into them, from the vesiculæ of the different sponge-cells, the superfluous water which they imbibe by endosmosis, apparently, during nutrition; for the type of *Spongilla* is to be surrounded with a general pellicula, in which there is only one excretory opening, and through which pellicula the ends alone of the spicula in bundles project; nor does it seem altogether far-fetched to conceive that the offices of glandular organs in higher developments may be performed, in some instances, after this fashion.

*Nucleus*.—By this term we shall understand, for the most part, an organ situated in the outer portion of the sarcode, which, when well marked, presents under the microscope the appearance of a full-moon (to use a familiar simile), with similar slight cloudinesses. It is discoid in shape, of a faint yellow colour, and fixed to one side of a transparent capsule, which, being generally more or less large than the nucleus

itself, causes the latter to appear as if surrounded by a narrow pellucid ring. In this state it is invariably present in *Amœba*, *Actinophrys*, *Spongilla*, *Astasia*, and *Euglena*, though difficult at first to recognise; particularly in the two latter families, where the pellucid space or capsule, at the bottom of which it is situated, is often the only visible sign of its presence. In *Difflugia proteiformis* it of course cannot be seen, from the thickly encrusted state of the test; but in a smaller and less encrusted species, which might be called *D. tricuspis* (from the trefoil form of the opening of the test), as well as in *Euglypha*, its position is posterior, and evident, from the largeness of the capsule, though the nucleus itself is so faint that even in *Euglypha* it can only occasionally be distinguished; while in *Arcella vulgaris* (Ehr.) it is constantly double and opposite.—In *Amœba diffluens* the nucleus itself occasionally presents a pellucid spot or punctum in its centre.

In *Vorticella* there is a long cylindrical organ, which appears analogous to, if not homologous with, the nucleus, and this, in a large *Epistylis* common here, and some other species of *Vorticella*, is wrapt once round the upper part of the buccal cavity, in the same manner as the ovary is wrapt round the visceral organs of *Salpa* among the Tunicata. Stein states that after *Vorticella miscrostoma* has become encysted, this organ divides up into embryos, which, when the parent integument bursts, come forth like "*Monas kolpoda* or *Monas scintillans*"; and he "assumes" that these monads, after having become fixed and stalked, pass into young *Vorticellæ*;* an assumption which can hardly be doubted, though it may be some time before chance favours its demonstration.

In *Otostoma*, and many forms of Ehrenberg's enterodelous class of animalcules, there is a similar organ, either of a circular, cylindrical, or fusiform, elongated shape. Also in *Oxytricha* there is something of the kind, and in *Himantophorus* (*Charon*, Ehr. *mihi*) it extends nearly all round the body, commencing from the posterior extremity, and terminating on the right side close to the vesicula.

The cylindrical organ in *Vorticella* not unfrequently presents a granular appearance, and the granules, which are minute, but uniform in size, appear to occupy the periphery; but whether they are inside or outside the wall of the cylinder, or in the substance of the wall itself, I have not been able to determine. Stein places them inside, in the form of a granular cylinder, and within this "nucleoli," † — nucleated, discoid bodies, into which the nucleus becomes divided.

* Ann. & Mag. Nat. Hist. vol. ix. p. 474 et 447.

† Die Infusionsthiere, &c. 4to, Leipsic, 1854. Taf. iv. fig. 24.

In the rhizopodous cell which inhabits the protoplasm of the *Characeæ*,* it is at first uniformly clear and transparent, then semi-opaque, and sub-granular; afterwards two or more distinct granules make their appearance; and finally, it becomes wholly granular, and much enlarged, or undergoes fissiparation; and thus gives origin to more cells, like the cytoblast of the vegetable kingdom.

*Use.*—It is impossible, in the present state of our knowledge, to specify the uses of the nucleus. One point, however, is evident, that it appears very early in the development of the freshwater Rhizopoda sponge-cell, &c.; and another, that it bears a close analogy to a similar organ in the vegetable cell, viz. the cytoblast, which also is the primary organ of this cell; and therefore, perhaps, we might term it the presiding organ, or consider that such are its primary offices over the development and life of these cells respectively. If we trace it from the Rhizopoda into the vegetable kingdom, we shall find it occupying the very same position relatively in *Amœba* that it does in the cell of *Serpicula verticillata*.† Thus, in some amœbous cells which settled down from their spherical into the plane reptant forms, the following sequence from without inwards was distinctly seen, viz. 1*st*, the pellicula and diaphane; 2*nd*, the molecular sarcode bearing the nucleus, and a layer of greenish granules *externally*; 3*rd*, the aqueous fluid of the centre;—and in the spine-cell of the leaf of *Serpicula*—1*st*, the cellulose cell-wall; 2*nd*, the molecular protoplasm, in which are embedded the green granules (viz. cells or organisms in which part of the protoplasm bears chlorophyll) and the cytoblast; 3*rd*, the aqueous fluid of the centre. The difference between cellulose and pellicula, and the absence of the vesicula, &c. are points which have so little to do with the analogy in question when the latter is followed up through *Astasia*, *Euglena*, *Navicula*, *Closterium*, &c. into *Œdogonium*, *Nitella*, and lastly *Serpicula*, that very little doubt will, I think then remain, of the offices of the nucleus in *Amœba* being similar to those of the nucleus of the plant-cell, whatever these may hereafter prove to be.—Here, again, I would return for a moment to the cause of sphericity in *Amœba*, and submit whether the cavity containing the distending fluid is that of the vesicula or the centre of the sarcode; since the aqueous cavity of the vegetable cell may then be analogous to the vesicula; for, as before stated, I have never been able to succeed in detecting the vesicula in *Amœba*

* Ann. & Mag. Nat Hist. vol. xvii. p. 101.—1856.

† This aquatic plant is selected for comparison because the circulatory movement is well marked in the cells which occupy the body of the leaf, and the cytoblast and protoplasm in the spine-cells of the margin.

when under a spherical form; although, the moment it becomes plane and polymorphic, this organ reappears, of its usual size, and endowed with its usual activity.

Much, however, as the nucleus may at first appear to be a presiding organ, there can be no doubt, from what will presently be stated, that its ultimate destination, in some organisms at least, is to pass into granules which become new beings.

*Ovules.*—This term will be applied to a number of discoid, or globular, nucleated cells, which appear together in the sarcode of some of the infusoria. At an early stage in *Spongilla, Amœba, Euglypha, Astasia,* and *Euglena,* these bodies consist of a transparent capsule, lined with a faint yellow film of semi-transparent matter, which, subsequently becoming more opaque and yellowish, also becomes more marginated or distinct, and assumes a nucleolar form. In *Spongilla* there is also a delicate, pellicular layer, which is endowed with a low power of movement.

I first noticed these ovules in the seed-like bodies of *Spongilla,* where they are enclosed in transparent globular sacs,* each sac holding more or less ovules, which are discoid in form, of different sizes, and accompanied by a great number of active molecular granules; and during the past year I have frequently seen such in *Amœba (diffluens mihi)*†, where they have been equally numerous, have borne the same characters, and have been accompanied by a number of active molecular granules, as in the transparent globular cells of the capsules of *Spongilla.* They occur also in *Euglypha alveolata,*‡ congregated round the hyaline capsule of the *nucleus,* from four to fifty, and mostly of the same size, but always globular, and accompanied also, as in *Spongilla,* by molecular granules. Such ovules may also be seen similarly situated in *Difflugia tricuspis* (H. J. C.), and in *Arcellina dentata* (Ehr.); enclosed in the latter in an ovoid capsule, which nearly fills the test. In *Actinophrys,* also, they appear to have been seen by M. Nicolet, as will be mentioned hereafter.

*Astasia* and *Euglena* constantly become filled with discoid cells of a similar kind, but in those of the former I have not been able to distinguish the capsule from the internal contents, on account of their smallness, and the incessant motion of the animalcule. In *Euglena,* however, they are very evident, and it is worthy of remark that each partakes of the

* Ann. and Mag. Nat. Hist. vol. iv. p. 87.—1849. Of the formation of the seed-like body, I need not say more here, than that it consists of a capsuled aggregation of ovule-bearing sponge-cells; while *Amœba* presents the same appearance, when pregnant with ovules, as one of these cells, and becomes capsuled singly.

† Dujardin, Hist. Nat. des Zoophytes Atlas, T. 3, fig. 1.

‡ Dujardin, tab 2, fig. 9.

form of the *Euglena* to which it belongs. Thus in *E. acus* it is long and cylindrical; in *E. deses* oblong, compressed; in *Crumenula texta* ovoid, compressed; in *Phacus*, circular, compressed, &c.

In *Spongilla* and *Amœba* these ovules follow the motions of the sarcode, in which they appear to be loosely imbedded; they also undergo partial transposition in *Astasia* and *Euglena;* but in *Euglypha* and *Difflugia* are located round the globular hyaline capsule of the nucleus, at the posterior part of the body,—a position which it is well to remember, for although apparently unconnected in all, with the nucleus and its capsule, and diffused generally throughout the sarcode in *Spongilla*, *Amœba*, *Astasia*, and *Euglena*, yet in *Euglypha* and *Difflugia*, which we shall hereafter find the best for typical reference, they are undoubtedly developed in the neighbourhood of the nucleus, and therefore confined at first to a particular part of the body.

In many of Ehrenberg's enterodelous infusoria it is not uncommon to see a number of defined globular bodies, of nearly equal size, and of a faint, opaque, yellow colour, which closely resemble ovules,—*ex. gr. Amphileptus fasciola* (Ehr.), *Himantophorus Charon* (Ehr.), &c.; nor is it improbable that many of his Trachelina, which come near *Planaria*, possess ovules similar to those which are found in the latter; but, from being so much mixed up with the spherical cells, pass equally unnoticed while in, as well as when out of the body, under such circumstances. M. J. Haime, however, has distinctly seen instances in which these bodies have been ejected from infusoria, and have passed into locomotive animalcules under his eye. Thus he states in *Plœsconia* they form a group of from forty to fifty in the middle of the body, are round, issue one by one, remain tranquil some time, then develope two filaments, one in front the other behind, and move about rapidly. In an "undescribed" species of *Dileptus* they are whitish, and form a wreath, extending almost throughout the whole length of the body, become yellow towards the anal extremity, where they pass out with the remains of the food, soon develope two filaments, opposite, and move about rapidly. In *Paramecium aurelia*, M. Haime states that an ovary appears some hours before death, about the middle of the body, which becomes filled with about sixty little nuclei; these increase in size, burst the ovi-sac, and thus pass into the body of the parent, from which they finally escape by an opening in the tegumentary covering, formed by the diffluence of the latter, and the ovi-sac follows them.*

*Spermatozoids.*—This term is provisionally applied to granules,

* Ann. des Ss. Nat. Zool. T. xix. p. 131, foot-note.—1853.

which are originally developed from the nucleus in *Amœba*, *Euglypha*, and *Spongilla* (?). In *Amœba* the process appears to commence by an increase of size in the capsule of the nucleus, which becomes more or less globular; at the same time the nucleus itself becomes uniformly granular; the latter then increases in size, so as to occupy a third of the interior of the animalcule, and then undergoes, apparently, duplicative sub-division, for the mass is sometimes seen to present a *single* groove, which passes through the centre, and ultimately becomes divided up into several segments. These segments assume a circular compressed, or globular form, and continue entire until the granules or spermatozoids of which they are composed become fully developed, when the latter acquire the power of locomotion, and thus separate from each other; meanwhile the original capsule of the nucleus for the most part disappears. In this way some individuals out of a group of *Amœba diffluens*, bearing such granules, were seen moving about, even when so reduced that hardly anything but their cell-wall, and the one or two spherical segments of the granulated nucleus that remained in its interior, were left; upon being delivered of which it may be presumed that they became effete or died. Sometimes these segments are evidently held together by a soft mucous cell, which, being polymorphic, assumes the form of *Actinophyrys*, and thus exhibits a locomotive power; while at others the cell becomes firm, transparent, and spherical, and the granules do not leave it until they become endowed with locomotion. When the latter is the case, the spermatozoids may be seen, if fully developed, to be bounding about their respective capsules, while the capsules themselves are still rolled on in the sarcode of the *Amœba* under progression. At other times the whole mass of spermatozoids, all separated, and having left their capsules, may be seen to fill the body of the *Amœba*, while she is still under active polymorphism and locomotion. Lastly, the parent sometimes dies in this state, and then the mass of spermatozoids may be seen to undergo gradual disintegration, as the granules, by twos and threes, or more, disentangle themselves from the sarcode, and bound off into their new element. These granules or spermatozoids in *Euglypha* average from $\frac{1}{12500}$ to $\frac{1}{10000}$ of an inch in diameter; about four of them would make the diameter of the largest ovules, which are, again, about the width of human blood-globules.

In *Euglypha alveolata* a similar development takes place round the anterior part of the capsule of the nucleus; but from the concealed position of the latter, I have not been able to see it distinctly originate in the nucleus, as in *Amœba*. The segments here have always been

compressed, probably from the soft polymorphic state of the mucous cell which encloses them admitting of their assuming a plane or reptant actinophorous form; and in this way they are carried out of the *Euglypha*, which, like *Amœba*, perishing on their development, and passing into decomposition, thus allows them to quit the parent cavity; at other times they separate close to the hyaline capsule of the nucleus, and finally swarm about in the test, generally. Although this development, as well as that of the ovules, takes place more profusely in different than in the same individual, yet it is by no means uncommon to see, in a group of ovule-bearing *Euglypha alveolata*, individuals with both developments in them at once; and with no gradation in the size of the ovules to indicate that they originated in the granules, or *vice versâ*,—the two developments thus appearing distinct; and this seems to be confirmed by what takes place in a larger variety (?) of this species of *Euglypha*, where there is a test something like that of the parent developed in the interior, and within this a spherical capsule, provided with a straight tube, which extends to the pointed end of the test in which it is immediately enclosed. At this time the animal has entirely disappeared, and the contents of the spherical capsule, having undergone segmentation, assume the form of circular masses of granules, like those developed from the nucleus in *E. alveolata*; after which the granules separate, and pass out of the straight tube, which is slightly patulous at its free extremity. Other tests of the same variety may be seen more or less filled with ovules, as before described.

Lastly, in *Spongilla*, there are always many cells to be found in that part of the mass where the seed-like bodies are being developed, partly filled with similar granules, loose or in a circumscribed group; but I have not yet been able to determine whether this development is nucleolar, or ovular at an early stage. It is certainly most like the granular development of the nucleus in *Euglypha* and *Amœba*.

In *Astasia*, irregular globular botryoidal masses, dividing up into spherical cells, colourless and translucent, or of a faint, opaque, yellow tint, present themselves so frequently (and generally inversely developed with the ovules, as in the Rhizopoda), that I cannot help thinking that they are developments from the nucleus; but from not having seen them present that granular aspect which characterises this development in the Rhizopoda, I have not been able to determine satisfactorily whether they are parts of the latter, or that kind of division of the green sarcode into green spherical cells which appears to be one mode of propagation in *Euglena*.

In *Euglena*, also, I have described a development of the nucleus, partly

under the idea that it might be a parasitic rhizopodous development; but now it appears to me to be a simple enlargement, granulation, and segmental development of this body into polymorphic, reptant, mucous cells, filled with spermatozoid granules, as in the Rhizopoda.*

Finally, from what organs, in the freshwater Rhizopoda, *Astasia*, and *Euglena*, are the ovules and the spermatozoid granules developed?

Of the origin of the latter from the nucleus there appears to me to be no doubt; for independently of the changes taking place in it which have been mentioned, I have never been able to see the nucleus and its capsule in its original form when the spermatozoid mass has been present, though I have occasionally, in *Amœba*, and almost always in *Euglypha*, seen the empty globular capsule in connection with the latter. In *Amœba*, before the spheroidal divisions of the nucleus have separated from each other, they frequently appear in the form of a botryoidal mass, projecting from one part of the capsule.

But, as regards the ovules, although they are unquestionably developed too, around the globular capsule of the nucleus in *Euglypha*, yet the fact of their being developed throughout the greater part of the sarcode which lines the cell of *Euglena*, and the same in *Astasia*, which is closely allied to *Amœba*, while in the latter they appear also to be developed from the sarcode generally, seems to indicate that they are developments of some part or parts of the sarcode—perhaps some of the moleculæ. That the two developments, viz. that of the ovules and spermatozoid granules, present themselves together in *Euglypha*, has already been stated, and the facts of the ovules in *Euglena* first becoming developed outside the capsule of the nucleus, and the granular development of this body following it, shows that the ovules are not developed from the nucleus. The capsule, therefore, in *Euglypha*, under these circumstances, as well as when there are ovules alone present, is often seen minus the nucleus; and the same in *Amœba diffluens*, where it may be observed rolling about with the ovules when the latter have, for the most part, reached their largest size. In these instances, too, the granules of the nucleus, if the latter has undergone this transformation, may be dispersed among the general mass, as the nucleus on such occasions has, if not absent, appeared faintly marked, probably from having become effete or atrophied,—the ovules and spermatozoids appearing to be inversely developed.

Nicolet has stated that in *Actinophrys* the generative organs consist of a central spherical membrane, enclosing little globules, which are the

* Ann. & Mag. Nat. Hist. vol. xvii. p. 115.—1856.

rudiments of "eggs," surrounded by a "gelatinous granular layer," the granules of which appear to be the reproductive organs.* But this simple statement, though bearing the semblance of fact, is too meagre, without illustrations, to be of any use. If his "spherical membrane" be the same as our capsule of the nucleus, after the latter has become globular, then certainly the ovules are not contained in it in *Euglypha*. Stein also figures the nucleus of his *Actinophrys oculata* in accordance with Nicolet's observations, viz. with a granulated nucleus, fixed in a spherical capsule, surrounded by a zone of granular plasma (?).† This, as will be seen hereafter, is very like the state of the nucleus in the rhizopodous cell of the protoplasm of the Characeæ, when the former is undergoing reproduction.

With reference to the organs of generation in the other infusoria, I can state no more than that while there is a fusiform nucleus in *Otostoma*, I also constantly saw a bunch of string-like filaments floating about its interior, which appeared to be attached near the buccal cavity; and although I could make out nothing more, I could at the same time only liken these to the generative apparatus in the *Planaria* mentioned, which floats round the buccal cavity and upper part of the membranous stomach in a similar manner.

*Impregnation.*—In the *Amœba* and in *Actinophrys* a union of two individuals is not uncommon, and many have noticed this in the latter. It has occurred to me, also, to see it in a species of *Amœba*, which, from its circular form, and the prolongations only taking place from one point of the circumference, appeared thus to present an anterior extremity, by which extremities several pairs of the group were united; and on one occasion two separated under my eye, when an attenuated prolongation of one seemed to be drawn out through a thick prolonged portion of the other. More convincingly and frequently, however, this union was observed in a group of *Euglypha*, where the anterior extremity of the body is distinct. Here the protruded parts, after having been united for some time, began to separate by constriction at the point of contact, which, soon diminishing to a mere mucous thread, became smaller and smaller, and more elongated, as the two individuals, retreating from each other, withdrew themselves into the bottom of their test respectively, from which they appear on such occasions never again to emerge. Lastly, in a group of *Euglena deses*, several couple appeared united by the tails, not only to one another, but fixed to the watch-glass at this point, where they continued until

* Compt. Rend. vol. xvi. p. 115.—1848.

† *Op. cit.* tab. v. figs. 25—28.

each sunk down, close to the other or separate, into capsuled forms filled with ovules,—a state which appeared so much the more to be the result of impregnation, from the number of couples thus united presenting every stage of ovigerous development in their interior, from mere molecular sarcode to repletion with full formed ovules. It is not an uncommon thing to see, among a group of *Euglenæ*, individuals chasing each other, becoming united head to head, head and tail, or tail to tail, and then separating with difficulty by a whirling motion, as if the bond of union were a mucous thread, which could be only twisted off in this manner. Two *Euglenæ* may also sometimes be seen united by the intertwisting of their filaments only, just like the congress of two snails.

All these unions appear very much like so many acts of conjugation; but when we find *Euglypha* as well as *Arcella* united, not only in pairs, but triply and quadruply, in this way, and the same with *Euglena viridis*, the connection of these phenomena with reproduction, as Claparède has stated,* becomes "exceedingly doubtful"; particularly as we have seen the spermatozoid granules developed from the nucleus and among the ovules; and this granular spermatozoid development, if it be one, does not take place until after conjugation. At the same time, in one group of *Euglyphæ*, nothing but spermatozoids were developed, while in another hardly anything but ovules appeared; and it was only here and there that both were found together; again, in the larger variety of *Euglypha*, the granules were developed in a distinct apparatus, and the ovules in the same manner as in *E. alveolata*, viz. in the posterior part of the body, outside the capsule of the nucleus.

Lastly, we come to the question whether or not these granules are spermatozoids? That the ovules in *Spongilla* pass into polymorphic cells I proved by experiment some years since;† and lately, I have repeated similar experiments, with the same results. Moreover, I have seen the ovule of *Euglypha* in every stage, from its first appearance in the test to the time when it has acquired the power of putting forth rhizopodous prolongations, after which the tests of very small *Euglyphæ* presented themselves in the same basin, which did not appear before the parents had died off, and left their ovules to shift for themselves. Hence this is one mode of propagation among the Rhizopoda, whatever the granules which we have provisionally called spermatozoids may be. Then, also, it has often occurred to me to see circular groups of spermatozoids undergoing disintegration or dehiscence in the test of

* Ann. & Mag. Nat. Hist. vol. xv. p. 286.—1855. † Idem, *loc. cit.*

*Euglypha*, while ovules were present, and granules like the former swarming round the latter at the same time; as well as granules of the same kind in *Amœba diffluens*, where the ovules have been far advanced in development. Also in *Spongilla* similar granules abound in the transparent globular sacs of the capsule which contain the ovules; and when the latter are set free by forcibly bursting the former, these little granules crowd round the large ovules so markedly that I made this observation several years since,* when I little thought that there was any reason for thinking them organs of impregnation. Lately, however, I have observed, that full half the larger ovules of the seed-like body, under this condition, have one of these granules in different degrees of connection with them, from simple approximation to almost undistinguishable incorporation; also that when the internal contents granulate on the third or fourth day after they have been set free, the prominence caused by the appended granule does not disappear until the whole ovule has passed into a polymorphic cell; that is, that after this no capsule or anything else remains behind, to indicate that the granule and its capsule, with this prominence, have not wholly become transformed into the new sponge-cell. This granule, however, is not entirely confined to the larger ovules, where it is for the most part affixed to the margin, but is also presented here and there by many of the small ones. In the larger ovules it bears, in size, the proportion of about one to eight, and the largest ovules average about $\frac{1}{2500}$ of an inch in diameter. About twelve hours after the ovules and granules have been set free in the manner mentioned, into distilled water, in a watch-glass, they, as well as the granules, exhibit a great deal of motion, which lasts up to the end of the first day, when they become quiet again; and this motion, though least in the largest ovules, and most in the smallest granules, is generally from one side to the other in all, like that of a zoospore which is attached to the glass by one of its cilia, or of a monad, which possesses a polymorphic coat attached to some body, and a moving single cilium. Some of the granules, however, every now and then appear to break away from this attachment, and then present a single (?) ciliary appendage, which ceases to be visible again the moment they become fixed. All the ovules, both those with which a granule is connected, and those without, appear to undergo a like granulation of their internal contents, and pass into new sponge-cells, which for a day or two remain polymorphic and reptant, and then assume a spherical actinophorous form; while there is also a development of single (?) ciliated monads, closely resembling those

* Ann. & Mag. Nat. Hist. *loc. cit.*

which are found in the fully developed sponge. In their reptant state, also, the former present the vesicula, and frequently a single cilium.

Under what circumstances we are to view the incorporation of this granule with the sponge-ovule I am ignorant. Certain it is, that one of these granules, which at first hardly appear to differ from the ovule itself, except in size, and the addition, perhaps, of a single cilium, may frequently be seen to exhibit movements about a large ovule indicative of a desire to become incorporated with it; and frequently, also, it succeeds, before the eye, in fixing itself permanently to its circumference; while occasionally a monociliated granule may be seen to be appended to one of the sponge-cells thus newly developed, in the same manner as the "zoosperm" attaches itself to similar cells in the old sponge.

In the absence, then, of direct evidence respecting the ultimate destination of these bodies, we must infer that they are germs, which grow into new individuals (perhaps like microgonidia),* or that they are impregnating agents, which enter into the ovules, and thus render them capable of further development, or both. Analogy, in connection with the facts mentioned, seems to favour the latter view; for when we observe the development of the ovules, and these spheroidal or discoid segments of the granulated nucleus, which are about the same diameter as the ovules, occurring together in the same *Euglypha;* and one cell, viz. that of the ovule, remaining entire, while the contents of the other, viz. the spheroidal segment of the nucleus, has apparently divided up into a number of locomotive granules, the process so far accords with what takes place in higher organic developments during the act of generation that we become much induced to extend the analogy still further, and consider that the contents of some of the spermatozoid granules or smaller cells go into this larger one to complete it, in the families of Rhizopoda &c. mentioned. The monociliated cells ("zoosperms")† of *Spongilla* might, perhaps, by some be considered young sponge-cells, which lose their cilium on further development; for such is the course with the monads which are produced from the rhizopodous cells of the protoplasm of the Characeæ before they pass into *Amœbæ;* while the number of the former being as great in the first portion of sponge which issues from the capsule as in the older mass, if not more so, seems not only to support this view, but also that they do not form part of the surface-layer of the canals in which cilia have been detected by Mr. Bowerbank, for at this period there are no canals present.

* See Braun on the reproduction of *Hydrodictyon*.—Ray. Soc. Pub. Bot. & Phys. Mems. pp. 261 et 89.

† Ann. & Mag. Nat. Hist. vol. xiv. p. 334.

The facts above mentioned, however, are opposed to this view; for there is a marked difference between the reptant sponge-cells produced from the ovules in the watch-glass, and the monociliated ones developed from the granules, both in size and appearance; and although the cilium subsequently seen in the former may have pre-existed in the ovule, still, both being polymorphic, rhizopodous cells, and, therefore, when united undistinguishable individually, the cilium might belong to either, *i. e.* to the sponge-cell or to the incorporated granule,—the latter of which may frequently be verified when examining a piece of *Spongilla* torn to pieces, under the microscope. Whether or not, however, both possess a cilium at first, the sponge-cell loses it afterwards, whatever may happen to that of the supposed zoosperm, which may not become incorporated with one; and this may be the case with the monads which are produced from the rhizopodous cell of the Characeæ,—there may be two kinds.

Should it be hereafter proved that the granules of the nucleus thus become impregnating agents, then this mode of generation may perhaps be extended through *Euglena* to *Navicula*, *Closterium*, *Spirogyra*, *Œdogonium*, and *Cladophora*; for in none of these Algæ has anything approaching to a process of generation been detected beyond conjugation and the formation of the spore; while, indeed, in *Spirogyra mirabile* (Hass.), *Œdogonium*, and *Cladophora*, the spore is formed without conjugation.—Might not the granulation of the nucleus, &c. go on in the spore?

In *Cladophora* the gonimic substance consists of nucleated cells, each containing a portion of green chlorophyll-bearing protoplasm, and these are arranged in the way of a pavement on the inner side of the cell; hence we must consider *Cladophora* a composite Alga, which would then form the first step to the cell of *Nitella*, in which the green chlorophyll-bearing cells would correspond to the same kind of organisms in the cell of *Cladophora*; but as the form of *Nitella* is more complicated, so it requires distinct organs of reproduction for its general development. That the conjectured mode of generation mentioned in the freshwater Rhizopoda may be the same as in the lower Algæ, and that the addition of other and distinct organs for this purpose in the higher developments is a necessary sequence of their complication, are observations merely put forth for what they may prove worth. At the same time, it appears evident that each organ must have its proper cell, and this cell its proper mode of impregnative reproduction, just as much as the most complicated beings of which it forms a part; while the granulating of the nucleus of a cell to furnish fertilizing germs for the process of generation, when a simple division of

it is only required for common reproduction, is perhaps not the least untenable view that may be held on the subject.

*Development of the Ovule.*—In *Spongilla* and *Euglypha*, this appears to take place by the passing of the transparent, faint-yellow film, which lines the interior of the capsule, into an opaque, yellowish, granuliferous membrane; synchronously with which it becomes more marginated towards the capsule, and presents, in the centre, a pellucid area, in the middle of which, again, is a minute granule or body, which appears to be the rudiment of the nucleus. Frequently, also, another layer, as before stated, is seen in the ovules of *Spongilla* external to the capsular one, and this appears to be endowed with locomotive power, as it generally presents a parabolical shape, extended out from one side of the ovule; after which the ovule in each becomes transformed, apparently wholly, into a polymorphic, reptant rhizopod. The same process, modified, appears to take place in the ovules of *Euglena*. Thus in *E. deses*, where they are of an oblong shape (and therefore unmistakeable, if nothing but a legion of this species pregnant with ovules be present), they are found like the ovules of *Spongilla*, viz. scattered over the sides of the vessel, and evidently have, in like manner, the power of locomotion in addition to that which both also possess of turning upon their long axis when otherwise stationary. This, perhaps, may be partly effected by the external membrane just mentioned. The pellucid central area in the oblong ovules of *E. deses* corresponds with the oblong shape of the capsule; but beyond this, and the central granule, I have not been able to follow their development out of the parent; though, from the number of young *E. deses* which present themselves under the circumstances mentioned, it may reasonably be inferred that they come from the ovules. The young *Euglenæ*, however, being so rapid in their movements when once the cilium is formed, it can hardly be expected that, except under a state of incarceration, their development can be followed so satisfactorily as that of the slow-moving rhizopod. Instances do occur, however, where the ovules gain the cilium within the cell, and there bound about, when fully developed, like the zoospores of Algæ within their spore-capsules. In this way I have seen them moving rapidly within the effete transparent capsuled body of *E. deses*, and in *Crumenula texta*, where the spiral fibre layer is so strongly developed as to retain the form of the *Euglena* for a long time after all the soft parts have perished. On these occasions the embryos are perfectly colourless, with the exception of a central point, which reflects a red tint; and on one occasion, while watching a litter in rapid motion within the capsuled body of *E. deses*, the capsule gave

way, and they came out one after another just as zoospores escape from the spore-capsule; but from their incessant and vigorous movement I was unable to follow them long enough to make out anything more about them. Kœlliker also noticed in *Euglena* "four to six embryos in one individual, and entirely filling it, which at last, furnished with their red point and cilia, broke through their parent, leaving it an empty case."* The same kind of development of the ovule probably takes place in all the Rhizopoda as in *Spongilla*, and in that of *Astasia* as in *Euglena*. I have seen young *Astasiæ* in an effete body of an old one, but could not say that the latter was the parent.

To Stein's original and valuable observations on the development of embryos, arising from the division of the nucleus in *Vorticellæ*, I have already alluded; and also to M. Jules Haime's statements regarding the ovules which he saw in the bodies of *Plæsconia*, *Dileptus*, and *Paramecium aurelia*. Neither, however, appears to have seen ovules in either of these infusoria sufficiently distinct to describe their composition in detail.

Lastly, I would advert here to the rhizopodous forms which *Vorticella* occasionally appears to assume when under gemmiparous reproduction. Stein has described it in *Acineta*, and I have since observed it in a rhizopod undistinguishable from *Amœba diffluens*; I have also seen *Vorticellæ* developed *singly* from *Acineta*; and am now compelled to return to the conclusion which I doubted formerly, viz. that the rhizopodous development which takes place in *Euglena* is a similar passage of the nucleus, and perhaps certain other contents of this infusorium, into a rhizopodous form.† This appears to be as general in the family of *Euglena* as in that of *Vorticella*; and although these two organisms at first look very different, yet, not only is their metamorphosis into rhizopodous forms similar, but the sudden contractile movement at intervals of a species of *Glenodinium* (Ehr., very nearly the same as *G. tabulatum*) is so like that of *Vorticella*, and *Glenodinium* so closely allied to *Euglena*, that we cannot help seeing in this act

* Qy. Jl. Microscop. Sc. vol. i. p. 34.—1853.

† This was the original view I took of it. I then conceived it to be a foreign development, like the rhizopodous cell of the Characeæ, for it took place in several *Crumenulæ*, which had respectively been enwrapped for a short time in rhizopodous cells, when I thought the germs of the new development might have been introduced into them. Still I wavered in my opinion, as may be seen in the latter part of my description of this (Ann. & Mag. Nat. Hist. vol. xvii. p. 115), and since then I have returned to the old view, which is that above expressed; for independently of other evidence in favour of it, *Euglena* would be an exception to what now seems to be a general occurrence in organisms closely allied to it, that is, if we considered this granular metamorphosis of the nucleus into polymorphic, rhizopodous bodies, a foreign development.

alone a feature which links together *Euglena* and *Vorticella*,—if not also, with other points of resemblance, the biphorous Tunicata or Salpidæ.

Hence then, as *Vorticella* may pass into *Acineta* or *Amœba*, and *Euglena* also into a rhizopodous cell, and the former may in its metamorphosis produce young *Vorticellæ*, so perhaps *Euglenæ* may produce young *Euglenæ* after a similar manner.

How, then, are we to regard this granulating development of the nucleus? We have seen that it occurs in *Euglypha*, where also there is a distinct development of ovules. Are we to regard it as the flowering of a diœcious male plant, or as the budding of a monœcious or bisexual flowering one,—as the impregnating element, or as a reproductive gemmiparous one? We can hardly consider it budding or gemmiparous, because it is a development of the nucleus itself, which allies it more to fissiparous or duplicative sub-division; and if this cannot be determined, perhaps it had better be called "granulation." Gemmæ grow out from the surface, and do not appear to contain any portion of the nucleus *(ex. gr. Vorticellæ)*; neither could I discover an elongated nucleus, as Stein has figured, in the *Amœbæ* and *Acinetæ* which I saw developing young *Vorticellæ*, the former in plurality (one to three), and the latter singly; if present in the amœbous form, it was circular, and if in the *Acinetæ*, undistinguishable from the general "granulation."

Again,—where are these transformations to end? Into what kind of rhizopods do the *sheathed Vorticellæ* pass? How many of the fresh-water Rhizopoda are alternating forms of *Vorticellæ*? How many actinophorous rhizopods those of *Euglenæ*? &c. are questions originating in Stein's important discovery, which not only indicate the necessity of further investigation, but a considerable approaching change in this part of the classification of infusoria.

It is desirable, also, that I should add here what little more I have been able to collect respecting the development of the monads in the rhizopodous cell, which dwells and multiplies in the protoplasm of the Characeæ.* This, it will be remembered, I conjectured to be by segmentation of parts of the diaphane and sarcode; but before making any further observations on the subject here, I will again premise a brief description of this cell. It is distinctly a rhizopod, like *Amœba diffluens*, or the sponge-cell, but of greater tenuity, and without, so far as my observation extends, a vesicula; that is, I have not been able to recognise this organ in it, though on dying it presents vacuoles. The nucleus, as before stated, is clear at first, then becomes cloudy, and presents one or more defined granules; afterwards semi-granular, and

* Ann. & Mag. Nat. Hist. vols. xvi. xvii. pp. 108 and 115, respectively.

opaque, and then uniformly granular throughout, when it appears to multiply by fissiparation in the parent cell, and thus to give rise to several daughter-cells, after the manner of a vegetable cytoblast; or to grow into an elongated granular body, of whose ultimate development, while within the living internode of the Characeæ, I am ignorant. But when the internode of *Nitella (ex. gr.)* is about to die, and this rhizopod seizes upon the green discs of the periphery and other nutritious matters of the interior, now deprived of the vitality which kept them together and thus exposed to the rapacity of the ascendant parasite, the nucleus undergoes various changes, which arrests of development at different stages, among the myriads which are presented to view, seem to elucidate. Thus the nucleus and its capsule, now surrounded by the nutritive contents enclosed within the sarcode, enlarges and passes from its discoid form (elliptical in the large *Nitella*) into a globular one: * meanwhile the former becomes distinctly and uniformly granular; the granules enlarge, and become refractive; they assume, *en masse*, a spheroidal form enclosed within a cell of their own, and thus become distinct from the capsule; at the same time one or more refractive (oil?) globules, or a nucleolus, may sometimes be seen in the latter. While this is going on, a zone of colourless plasma (?) forms all round the capsule of the nucleus, which thus becomes separated from contact with the now hardened cell-wall or pellicula, as well as from the diaphane and sarcode. The next stage is the bursting of the proper cell, and passage of the granules of the nucleus into its capsule, and from thence into the soft plasmic zone which surrounds it. After this, the plasma assumes a mulberry shape, and divides up into monads, which feed upon the enclosed nutritive matters, and are at length seen in the position of the sarcode and diaphane, now circumscribed by a transparent delicate membrane, the second pellicular cyst.† That the refractive granules of the nucleus, and portions of the enclosed nutritive contents, which are coloured brown by the dead chlorophyll, get into the bodies of the monads, cannot be doubted, as such matters are seen in them, and could come from no other source. Frequently, however, cells

* I must infer this, because the nuclei in the large species of *Nitella*, as well as in *Chara verticillata*, are all elliptical.

† Is this degenerated pellicula and diaphane or a new cyst, composed of the former only? I am now inclined to the latter theory, here as well as in *Otostoma* (Ann. & Mag. Nat. Hist. vol. xvii. pp. 108 & 118 respectively), and that in *Otostoma*, the ciliated coat is divided up for the new litter, while in the rhizopodous cell of the Characeæ the diaphane and secreting organ of the pellicular cysts perish or pass into dissolution. (See the discussion on this point *ante* pp. 432, 433.)

may be seen, apparently under an arrest of development, where the plasmic zone has assumed a sub-tuberculated or mulberry form, and the granules of the nucleus are still in their globular cell within the capsule; hence it may be inferred that the segmentation of the plasma commences before the granules of the nucleus get into it. Again, in a more advanced but still arrested stage, the capsule of the nucleus is seen to be empty, and its bright granules, in the little pouches or mulberry-shaped excresences of the plasma, now reduced to a mere membrane by arrest of development. From which it may also be inferred that each pouch, which represents a monad, receives one or more of the granules of the nucleus. Does the tuberculated or mulberry surface of the plasmic zone, thus under an arrest of development, indicate that it has taken this shape from consisting originally of a number of ovules enclosed within a globular membrane; and if so, is the passage of the granules of the nucleus into them to be considered an act of impregnation? If they were ovules, then one would think that there would be no occasion to lay up extraneous nutrition for them more than *Euglypha* or *Spongilla*, &c. has need to lay up for their ovules, which, after the parent perishes, remain for a certain time in the effete body, and ultimately undergo a kind of incubation, generally after they have left the cavity in which they were developed. Again, though very much like the granulating of the nucleus in *Euglypha* and *Amœba*, where the bodies which are thus evolved singly or in groups generally become endowed with active locomotive power before they leave the parent; yet in these instances no plasmic zone around the nucleus preparatory to this has been observed.* In the present stage of our knowledge, therefore, we are not able to say whether this be a gemmiparous or a generative process; whether monads developed in this way are merely multiplied zoosperms of this organism, or the mixed product of a genuine generative process; whether there be, in addition, an ovular development, as in *Euglypha*, &c.; or whether the monads thus developed soon perish, or become new cells. Certainly in *Spongilla* there are two kinds of developments, viz. the so-called zoospores or monads, and the transformation of the ovules directly into the sponge-cell: both are polymorphic, and at first have each (?) a single cilium; but one being much smaller than the other, they may perhaps be regarded respectively macrogonidia and microgonidia, as Braun has suggested for the zoospores of *Hydrodictyon*.† From whence, then, come the so-called zoospores in the latter—from the granules of the nucleus?

* *Actinophrys oculata* (Stein), however, presents a nucleus and plasmic zone of this kind. (See p. 454.)

† Ray. Soc. Pub. Bot. & Phys. Mems. *loc. cit.*

Lastly, there are two organs in those *Euglenæ (mihi,* which for no just reason Dujardin has separated from this family), viz. *Phacus* (Ehr.) and *Crumenula texta* (Duj.), that I should notice here, though I am perfectly ignorant of their use. These are the so-called "red spot," which in *Crumenula texta,* where it is comparatively very large, rests in the form of a small obtuse cone upon the vesicula; and the glary capsuled body, which always exists in the centre of *Phacus,* and in the long lip of *Crumenula texta,* &c.;—in some *Euglenæ* there is an undefined yellowish body here.

Of what use the "red spot" or body may be I am ignorant; but it is very common to see matter like that of which it is composed multiplied throughout the body of *Euglena,* both in an amorphous and molecular form; and when nothing but the ovules remain in the colourless, transparent, fibrous cells of the two species mentioned,—to see little granules of it moving with a more than Brownonian motion among the ovules. Ehrenberg regarded it as the rudiment of a visual organ; and perhaps he is right, for there seems to be very little difference between the pigment of the skin of a Negro and the pigment of the choroid membrane of his eye, while the latter is confined to the eye alone in white-skinned people. Again, in some of the Rotifera, it is not uncommon to see the material of which the red pigment of the eye is composed, more or less dispersed in a molecular form, though it is generally confronted by a bluish refractive matter, corresponding, perhaps, to the vitreous humour and lens. Also, in the so-called blind *Planaria,* there are organs like eyes with flat corneæ, but no pigment; and when the animal is about to divide into two across the stomach, the first indication appears to be an inversion of the integument which is to form the future eye, and at the same time a covering of it with cuticle, which thus supplies the cornea. Finally, then, as we find in the Albino eyes capable of seeing without the presence of pigment; the eye formed by an induplication of the skin; the pigment dispersed over the body, as well as in the eye in the Negro, while it is confined to the eye in the white races, we are led to the conclusion that the red body in the family of *Euglena,* though not necessarily indicating sight, may nevertheless mark the point where something of this nature exists in this, as well as in other infusoria of the kind, although, as in *Astasia,* it is not similarly marked, any more than in many animals wherein a visual organ is present without this accompaniment.

In a small species of *Euglena,* which dwells in the brackish water of the main-drain of Bombay, and which, after having been placed in fresh water, assumes the still, protococcus form, multiplying itself by fissiparation and internal segmentation of the sarcode, after the

manner of vegetable cells, and occasionally in linear arrangement, like the filamentous Algæ, the red body is as often omitted as repeated in each cell; while in the active state, previous to *longitudinal* deduplication, the red body always becomes dual, one on each side the vesicula. But in transverse fission it is frequently absent in the lower half, and only remains in the longitudinal divisions of the *anterior* one. It is interesting, too, to observe that this body is present in the gonidia of *Ulothrix zonata*, one of the filamentous Algæ, and that it also is confined to the first cell in fissiparation, which so far corresponds with *Euglena*, that when the latter assumes a fixed or algoid form, by capsulation, the peduncle of the pellicula is extended from the anterior, ciliated extremity. This also is the part which develops the root-like prolongations in *Œdogonium*; and probably the gonidia of *Ulothrix* grow after the same manner; when the red body would remain in the inferior half, and not be repeated, as in *Euglena*, when the latter fissiparates, in the still form, transversely.

With reference to the single, glary, capsuled body which exists in the centre of *Phacus*, and in the large lip of *Crumenula texta*, also dually in *Euglena geniculata* (Duj., *spirogyra* Ehr.), one on each side the nucleus, I can state nothing further than that in the two first it consists of a discoid transparent capsule, which at an early stage appears to be filled with a refractive, oily-looking matter; that it is fixed in a particular position, and remains there apparently unaltered, with the exception of becoming nucleated, until every part of the animalcule has perished, and nothing is left but the spiral-fibre coat, and perhaps a few ovules. In *Euglena geniculata* it is baccilliform, and contains a correspondingly shaped nucleus; and although I can state nothing respecting its uses, I cannot fail to see that it has an interesting analogy, particularly in the latter instance, with two similar organs, which are commonly seen in the *Naviculæ*, and which in *N. flava ex. gr.* are situated in a variable position, between the nucleus and the extremities on either side. In this species they make their appearance as little specks, generally previous to the development of the oil-globules, &c. and, enlarging rapidly, assume a globular form, which consists of a transparent capsule, enclosing a glary, refractive, oily-looking fluid. As the starch and oil-globules are developed and subside, these glary globules become distinctly nucleated, sometimes irregular in form, or pedicled to the endochrome-bearing protoplasm, and, like their apparent analogue in *Crumenula*, &c. remain in the frustule when everything else has become decomposed, or has passed into minute brown-red granules (sporules?), when they present a central, glary, circular nucleus, surrounded by a double globular capsule, neither of

which, like the globule in *Crumenula*, takes any colouring from a solution of iodine. I need not here go further into the description of this organ in *Navicula*: suffice it to say, that it also appears constantly in a large species of *Amphiphora* common in the brackish water of the main-drain of Bombay, where it assumes the form, when fully developed, of an elliptical body, terminated at each end by a compressed, truncated, or obtuse elongation, like a barrel, and is always attached to the circumference of a vesicle. I should not have written so much about this organ here, but as it is not (as generally, I think, supposed to be) a common oil-globule, and we know so little of the organology of the *Diatomeæ*, while its occurrence in *Navicula* seems to add to the other points of alliance which exist between the *Diatomeæ* and *Euglenæ*, its mention may not prove useless or uninteresting to those who are engaged in these studies.

Here I should not omit to add that the resting-spore or macrogonidium (Braun) of *Œdogonium* develops a number of capsules like the ovules of *Euglenæ;* and that though they occasionally exhibit, under the action of iodine, a blue tint, indicative of their amylaceous nature, yet when fresh, and newly formed, they only take the brown-yellow one invariably presented by the ovules of *Euglena* under the same circumstances. Similar colourless capsules may also be seen moving about cells of *Œdogonium* whose contents have left their walls, and appear to have partially progressed towards that of the spore, without having had strength to assume the globular form; and these very much resemble the ovules of *Crumenula* when moving by the aid of a cilium within the effete transparent cell. All must allow, from what I have stated respecting the cell-contents of *Œdogonium flavescens* (Kg.), viz. that under favourable conditions, when the cell is broken, they can leave it bodily, form into a spore, and swim about by aid of their cilia, and that the germs of *Œdogonium* can pierce the sheath of *Oscillaria princeps* (Kg.), and germinate between its cells, are phenomena of a kind much more common to the animal than to the vegetable kingdom.

In conclusion, I have only to remark that the reader is requested to view all speculative suggestions in this summary of my "Notes" as mere cursory observations, introduced for the purpose of calling attention to subjects which are deemed worthy of consideration; the study of this part of organic creation being so much in its infancy, and so intricate, that hardly anything but that which has received ocular demonstration should be taken for *fact*.

ART. VI.—*Further Observations on the Ruined City of Brahminabad, in Sind.* By A. F. BELLASIS, Esq., Bombay Civil Service.

Read April, 1856.

SINCE March 1854, when I first commenced to excavate amid the ruins of Brahminabad, I have visited the ancient city on three several occasions. In these rough notes I purpose to mention the result of my researches, and, without entering into much detail, I proceed to describe any discoveries of special interest.

On the occasion of our second visit, we selected for excavation a heap of ruins adjoining the site of the house first excavated, and standing on the verge of the same bazar. The house was built of burnt brick, and the rooms of similar construction to those before described. Among the first things of interest found were some very curiously carved stone slabs, raised about five inches from the ground, on four feet. They were carved out of a solid block of stone, but, with one exception, were all more or less broken into pieces by the weight of the walls that had fallen upon them. I was, however, successful in finding all the pieces of some of them, so that the whole could be put together. They varied in size from two to two and a half feet square.

The most beautiful was one of red sandstone, similar to that now found at Porebunder in Kutch. The slab is square, with a large circular space in the centre, the corner pieces being ornamented with peacocks and snakes. This circular space is slightly depressed, for the retention of water, and on one of the sides of the slab is a bull's head, with the water escape passing through the bull's mouth. In this specimen the four corner feet were panelled, and exquisitely carved with bass-relief figures, two on each foot. Two feet were wanting, but on the two found the figures were, a lion on one panel, and on the other a warrior armed with sword and shield. On the other foot are two female figures, one playing the Surindah, a kind of guitar still in use. The other female appears to be admiring herself in a looking-glass, which she holds in one hand, while with the other she is dressing her

hair. These feet are connected with each other by a cornice of open tracery of great beauty, running along the sides of the slab, and the whole forming a beautiful specimen of carving.

The figures, and all the emblems and ornaments used, are Hindoo, such as are seen on old Jain temples. One remarkable fact is that the figures carved on this slab are quite perfect, and have not been mutilated by any iconoclast.

The followers of the Prophet were such zealous image-breakers, that in their invasions and conquests they rarely failed to mutilate every idol they saw. Among the Kafir Kotes near Jerruck, where some Buddhist remains were found highly ornamented with figures, not one escaped defacement,—even on a cornice, where the figure of Buddh was repeated again and again, the chisel of the iconoclast had taken the trouble to deface every head. It may therefore be inferred, from finding these figures entire, that Hindooism was still paramount in Brahminabad at the time of its destruction by an earthquake, and that the tide of Mahomedan invasion had either barely reached so far into Sind, or that the conquest was far from complete; and this is an incidental coincidence which accords with history.

I found many other slabs of the same kind, but none so richly carved; they were all found buried very deep in the ruins, and near the lower floors. Their use was evidently connected with religious worship. They may have been probably used by the Hindoos of Brahminabad to place their idols upon, and to perform the ceremonies of their ablutions; but, strange to say, although I made careful search, I found no idol. It has been suggested, that these idols were their household gods, their Penates, and these would be the very first things the inhabitants would endeavour to save.

Among many other curious articles found, four lumps of clay, with the proof impressions of a number of seals, deserve mention. The seal engraver, to whom these belonged, was evidently in the habit of keeping proofs of all the seals he engraved and sold, by taking their impressions in these lumps of fine clay. The characters and devices of the seals were quite fresh on the impressions, and there are as many as fifteen to twenty impressions on each lump of clay.

On the third occasion that Mr. Richardson and I visited Brahminabad, we excavated a house in the same bazar, but some little distance higher up, and were richly rewarded, by finding some beautifully carved figures in ivory. The largest is about four inches long,—a female standing figure, with a lotus in one hand; many of the other figures appear to be dancing-girls; the female with a looking-glass, on the slab above described, is again to be recognised, and also another warrior; an elephant, fully capa-

risoned; and other figures, in all about fifteen figures. These also were in no way defaced by the hand of the iconoclast. From the manner in which they were found, all close together, I conclude that they were portions of a richly carved ivory box,—some appeared injured by fire. The ivory is much decomposed, and is very brittle, and, with pressure between the fingers, may be reduced to powder.

In this same house we were further repaid by finding nearly a complete set of ivory chessmen, one set white, the other black. The kings and queens are about three inches high, and the pawns about one; the other pieces of different intermediate heights. All have been made for use on a board with holes, for each piece has a peg in it, similar to chessmen used now-a-days on board ship, to prevent the pieces being easily knocked down, and the game disturbed. The ivory of these too is in a very decayed state, and very brittle; every particle of animal matter seemed completely exhausted, and the ivory reduced to a substance not unlike lime or chalk. Dice were also found,—some square cubes of ivory, numbered exactly as dice used at the present day; others, the long dice, used by the Natives to play the game of Punchweshee. The discovery of these chessmen is a curious fact: they are probably the oldest known set in existence, and tend to confirm Sir William Jones' assertion that chess was a game of Brahminical origin.

The *Encyclopædia Brittanica* gives the following account of the history of the game:—

"With regard to the origin of the game of chess we are much in the dark. Though it came to us from the Saracens, it is by no means probable that they were the original inventors of it. According to some it was invented by the celebrated Grecian hero Diomedes. Others say that two Grecian brothers, Ledo and Tyrrheno, were the inventors; and that being much pressed with hunger, they sought to alleviate the pain by this amusement. According to Mr. Irwin, it is a game of Chinese invention. During his residence in India he found that a tradition of this nature existed among the Brahmins, with whom he frequently played the game. But according to Sir William Jones, this game is of Hindoo invention. 'If evidence were required to prove this fact,' says he,* 'we may be satisfied with the testimony of the Persians, who, though as much inclined as other nations to appropriate the ingenious inventions of a foreign people, unanimously agree that the game was imported from the west of *India* in the sixth century of

* *Asiatic Researches*, vol. ii. mem. ix.

our era. It seems to have been immemorially known in *Hindostan* by the name of *Chetorangá, i. e.* the four *angás,* or members of an army; which are these,—*elephants, horses, chariots,* and *foot soldiers;* and in this sense the word is frequently used by epic poets in their description of real armies. By a natural corruption of the pure Sanscrit word, it was changed by the old Persians into *Chetrang;* but the Arabs, who soon after took possession of the country, had neither the initial nor final letter of that word in their alphabet, and consequently altered it further into *Shetranj,* which found its way presently into the modern *Persian,* and at length into the dialects of India, where the true derivation of the name is known only to the learned. Thus has a very significant word in the sacred language of the Brahmins been transformed by successive changes into *axidrez, scacchi, échecs, chess,* and, by a whimsical concurrence of circumstances, has given birth to the English word *check,* and even a name to the *Exchequer* of Great Britain.' "

We also found the remains of an inlaid tortoise-shell or ebony box. I at first thought it was the chess-board, as it was found in the same house as the chessmen, although in a different room; but I could find none of its numerous pieces with a hole fitting the pegs of the chessmen. It had been an elaborate piece of inlaid workmanship. Some of the fragments are circular, others oblong, others triangular; some with a border pattern cut upon them, others with open carved work; and I think a careful examination of the pieces will show that the box was inlaid in ivory, ebony, and tortoise-shell, and perhaps with other materials.

I have had accurate drawings taken of most of these relics, of the carvings on the slabs, of the ivory figures, of the ivory chessmen, &c. &c., and these I have sent, with the originals, to Lieutenant Colonel Sykes, F.R.A.S., at the East India House.

Pottery, glass, glazed-ware, &c. were found in great variety and abundance, as described in my first paper on Brahminabad; also copper coins, cornelians, and cornelian chips; onyxes, agates, beads, women's bangles of glass, of ivory, and of brass. Bones and teeth, both of men and of animals, were abundant in every house. In one was found the head of a rat; in others, the bones of fowls; and the teeth of camels, oxen, and horses were very common. Beyond a few engraved seals, I found nothing with any inscriptions.

On the fourth occasion we determined to excavate in quite a different part of the city. We selected a very large mound of ruins near to the standing tower, supposed to be the site of King Dolora's palace; but

here we were not so fortunate, as we found nothing of special interest. I do not think we excavated sufficiently deep to reach the foundation. The walls of this house were far more substantially built, and the appartments of larger dimensions. Some of the walls, three and four feet in thickness, were to be seen thrown out of the perpendicular, as if by the rude shock of an earthquake. In this building more lime than usual was found, and the face of one wall had been plastered with lime.

Respecting the cornelian ornaments found figured with patterns in white lines, on a perfectly smooth surface, and which I thought were so curious in my first paper, I have made further inquiry; and while at Sehwan, in Upper Sind, an old city famed for cornelian engravers, I found some stones figured in exactly a similar manner. On examination, it was ascertained that the chief ingredients used were potash, white lead, and the juice of the Kirar bush *(Capparis aphylla)*, made into a thick liquid, and applied with a pen on the cornelian, which, on being exposed to a red heat in charcoal, rendered the device indelible.

On my last visit to Brahminabad, I made inquiry of an old cultivator if he had ever seen any of the round solid balls of pottery mentioned in my first paper. "Saheb," rejoined the old man, "come to the Toph Khana (arsenal), and I will show you plenty." I followed his guidance, and he led me outside the city walls, and across the dry bed of the river, and there, in the plain, sure enough were a number of these pottery balls. I could distinctly see the square heaps, in which they had been piled in regular rows like round shot; and, scattered over the plain, numbers of single ones were to be found, slightly embedded in the soil. They were of various sizes, some as large as 12-pounders, others about the size of billiard balls. The old man accounted for there being so many scattered about the plain by saying that in ancient times a great battle had been fought on that spot. The smaller balls might have been used in a sling, but the larger ones would have required some engine like the balista to propel them.

Besides Brahminabad, there are the remains of several other cities on or near the supposed ancient course of the river Indus. Besides those mentioned in my former paper, Captain Kirby has discovered one near Roree, of great extent; and I also saw the ruins of a small town near Soofee, on the Narra, fourteen miles west of Omercote, when travelling between Meerpoor and Omercote.

Captain Kirby's account, which is very interesting, I give entire:—

"In excavating the great Narra Canal, at a distance of about two miles and a half from the town of Roree, we occasionally came upon

detached masses of brick-work, and at length, at a depth of about ten feet below the surface of the ground, the foundations of a very large number of houses were laid bare. These foundations consisted of stone, or of mingled stone and brick-work, and resembled those to be seen in the ruins of the city of Arore at the present day, where it will be observed that the foundations of the houses are generally built of stone to a height of two or three feet above the ground, and the walls which rest on this foundation are composed of mud or unburnt bricks.

"In one instance the earth in the centre, and also outside the walls of one of the foundations I have mentioned as having been discovered ten feet below the surface of the ground, was removed, and the walls left standing: they then appeared to be those of a house, containing one room about sixteen feet in length by ten in breadth, and two smaller ones about ten feet by six. At another place, where the canal had been excavated to a depth of about twelve feet below the surface of the ground, a circle of stone-work was observed, between three and four feet in diameter. The earth was removed out of the centre to a depth of about two feet, and after taking out two or three broken vessels of brick-work, a crowbar penetrated several feet lower down without meeting with any resistance; unfortunately the water immediately rose to the surface, and prevented, for the time, any further excavation.

"In proceeding from the direction of Roree, the first of these ruins which we came upon were those of a large wall of considerable height, about four feet in breadth, extending from one side about a hundred feet into the canal, and built of extremely good and well burnt bricks. This wall has been hitherto excavated to a depth of about twelve feet. It may probably have formed a portion of the walls of the town, as I am not aware of any ruins of houses having been discovered on the northern side of it. From this point towards the south-east, the foundations of houses extend about seventeen hundred feet along the bed of the canal. Amongst these ruins were found a number of articles made of brick-clay, such as drinking cups, a Khooza, some water-spouts, and a large number of children's toys.

"There were also found some round stones, which have all the appearance of having been used as weights. I did not find any which exactly corresponded with the seer of the present day, but they almost all did with the chittak :* for instance one stone was exactly two chittaks, another four, a third six, and so on.

"It appears that the town was built on the extremity of a rocky hill, and that it has been gradually covered by the mud held in suspension

* An Indian weight of 900 grs. Troy, or little more than 2 oz.

by the flood-waters of the Indus, which even now flow over the spot; indeed its burial-ground, which (according to the common custom in this part of Sind) was high up upon the rocky hill, is still uncovered.

"The name of the place, it appears, was Hukrah, a name still retained by a village in the neighbourhood; and it is, according to the Natives of the country, mentioned by a prophet of the Mamooee caste of Fakeers, who says,—

'When broken shall be the bund of Arore,
And the water shall flow over Hukrah,
Where will be the fishing of the Summah?'

"Probably with the idea that when the bund of Arore was broken, and the waters flowed over Hukrah, the river Indus would have taken that course, and left its present bed dry. The bund of Arore, however, is not yet broken, nor is there much chance of its being so, as it has been lately repaired, partly with the bricks which were removed out of its old neighbour, the town of Hukrah, when excavating the channel for the canal.

(Signed) "J. H. KIRBY, Captain,
"*Arore, 17th August* 1855." H. M. 86th Regiment."

This city, which appears to have been built of pucka brick and stone, and to have been fortified, is in its general characteristics like those of Brahminabad, &c., but quite unlike any cities now inhabited in Sind, which are all built of unburnt brick and mud. It however differs in this respect, that although it was built on a rocky hill, it is subject to be inundated by the floods from the Indus, and has been buried gradually by the silt held in suspension by the flood-waters; whereas the ruins of Brahminabad and the other cities are all above ground, and have no signs of having been inundated.

It has been suggested, that the finding of these cities built with burnt brick and stone, in a country where these materials are no longer used, is evidence of a great climatic change. It has been said that "in nearly rainless districts, such as Sind, Egypt, and part of Beloochistan have long been, the expensive operation of burning bricks is never thought of where it can be dispensed with; and we are fully warranted to infer that a thousand years ago, when a precaution was found indispensable which is now superfluous, Sind was blessed with regular falls of rain." —*(Bombay Times.)*

I shall now conclude these observations with an account of Brahminabad by Captain F. J. Goldsmid, of the Madras Army, who was employed in Sind, and whose intimate knowledge of Persian gave him

many opportunities of consulting Persian books and MSS. After reading my first paper on Brahminabad, he drew up the annexed memorandum, which I give in an appendix, as it contains many additional particulars relating to the history of the city.

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## APPENDIX.

*Memorandum on Diloo Raee and Bhambro or Brahminabad. By Captain* F. J. GOLDSMID, *Madras Army.*

It is by no means easy to form a complete chronological chain of events from the various links supplied by Native chroniclers. Want of accordance, of intelligibility, of the information most essential,—these are serious drawbacks to satisfactory and uniform workmanship. The following few notes may be useful in drawing conclusions as to recent discoveries; they are from the same source whence the Syuds of Tatta derive their historical knowledge. Sabir Ali Shah is himself the lineal descendant of the author of the "Toohfut-ool-Kiram." The Chuchnama contains the name of Brahminabad frequently. It was a bone of royal contention to the Hindoo dynasty, which included the Sehreses and their sons. The Ayeen Akbaree refers to it as the ancient capital of the territory known in after years as the Sircar Tatta. It is therein described to have been once a very populous city, containing a fort of 1,400 bastions, a tenab distant from each other. Considerable vestiges of the fortifications were extant in A. D. 1600, in the reign of Akbar.

2. There are two Diloo Raees in early Sindian history, and the dominion ascribed to each proves that the Moslem conquest of Sind was far from complete for the first three or four generations after the invasion of Mahomed Kassim in A. D. 711.

3. The first bearing the name is met with in the account of the Lieutenants of the Banee Oomya,* whose respective reigns may be thus adverted to:—

1*st.*—Ahruf bin Dais. He held Alore. The Hindoos revolted after the second year of his government, and the country from Debalpoor (Tatta) to the sea remained in the hands of the Moslems.

2*nd.*—Aboo Hife.

3*rd.*—Tanreem bin Tiab.

* Toohfut-ool-Kiram, vol. iii.

4*th*.—Amr bin Abdoolla.
5*th*.—Amr bin Mussallim.
6*th*.—Suliman bin Asham.
7*th*.—Abool Kittah.

This period is from 93 to 133 Hijree, during which there appears to have been also in Sind a king named Diloo Raee, of the race formerly dominant, who lived in Diloor, so called after his own name. It may be natural to suppose that the revolt above alluded to was but a renewal of the struggle on the part of the vanquished Hindoos, with a view of ousting the invaders, whom they succeeded in driving to the borders of the sea.

4. During the same period of forty years, there is mention made of a second Hindoo king, named Bhamboo Raee, the founder of Bamboor, in connection with whose reign is introduced the tale of Sassooee and Punhoo. Now, if the locality given to the legend be that of the city in question, the Hindoos must at the time of its foundation have re-possessed nearly the whole country.* "It is situated on the right of the road from Wuttejee to Gharra." Lieutenant Burton adds: "The town is supposed to have been built upon the plain, and was destroyed by divine wrath in one night, in consequence of the ruler's sins"; thus identifying it with the Bhamboora on the opposite bank, the subject of these notes.

5. In the account of the Lieutenants of the Banee Abbas,† we hear of fresh armies and fresh conquests. It is related that one of these Chiefs, Moossa, "restored all that he took," or was "as generous as successful"; and received his dismissal from head quarters in consequence. The inference would be, that extension of territory was a grand aim of the Moslems in those days; nor could this well be denied by any true believer, the object being synonymous with extension of the faith.

6. During this government (Banee Abbas), and probably at some period in the fourth century of the Hijree, or indeed the date mentioned in the paper on Brahminabad (*ante*. p. 416), it was found desirable to strengthen the Arab tenure in Sind by an additional number of settlers. The Banee Tameen and the men of Saumra ‡ were the most famous

* Burton's Sind Note 25, page 389. † Toohfut-ool-Kiram, vol. iii.

‡ Mr. Bird's Memo., drawn up from Mahomed Masoom's history, and Dewan Muta Mull on this subject; for Dr. Burnes shows that the Soomras derived their name from Tanimrah, on the Tigris. But he makes Diloo Raee, and Chota, Soomras themselves. If the former were, however, a member of the old Hindoo royal stock, one could hardly transfer his Brahminical thread to the neck of a flesh-eating Arab, even in imagination.

of these. From the latter spring the Soomras, who eventually ruled the land. During this emigration we learn that Chota Amranee, brother to Diloo Raee II., lent his aid to the cause by proceeding to Bagdad, and returning with a hundred Arab followers. But the narrative of his importation of a wife is the more important to elucidate the present question, and is related in the Toohfut-ool-Kiram as follows:—

"They say that Diloo Raee, after the destruction of Alore, came to reside at Brahminabad. He had a brother by name Chota Amranee, son of Amr.* The Almighty had converted him in youth to the blessings of Islam. He had left the city, and learnt the Koran by heart, also the usages of Mahomedanism, in the most approved fashion. On his return, his friends wished him to marry: some one said jestingly on the occasion, 'Let this renegade go to the Kooba, and wed with the daughter of such and such a famous Arab.' By good luck, and his brother being then young, he determined to go on a pilgrimage. When he arrived at his destination, he saw a woman at a shop, busy reading aloud the Koran. He stood to listen. The reader said, 'Why are you standing there?' 'To hear the Koran' he replied: 'if you will kindly teach me the various readings I will be your slave.' The woman said, 'My teacher is such a one, the daughter of such a one: if you will change your clothes, and put on a maiden's vesture, I will take you to her.' He consented, and was shortly in the damsel's presence. She was skilled, among other accomplishments, in astrology. One day the woman who had introduced Chota asked some questions from her regarding her own daughter's marriage. When the reply had been duly communicated, Chota said, 'Since you know the state of others, assuredly you are acquainted with your own.' The damsel replied,—'It is well remembered; you have now looked into your own destiny.' She added, 'I am to be united to a man from Sind.' He asked, 'When?' She answered, 'Soon.' He continued, 'Where is the man?' She consulted her tables, and replied, 'You are the man.' When the veil had thus been removed from Chota's destiny, the expounder of the Koran said, 'Begone, and come no longer in the guise of another. Take off these clothes, appear as yourself, and seek my hand, for I am destined to be yours.' Then, after acquainting her parents, she became the bride of Chota. The latter returned to Sind, and took the beautiful Fatima with him. When he reached the city of Diloo Raee, that tyrant had established a custom that all newly mar-

* Mr. Bird's Chota is descended from Oomra Soomra. It should be noted that the family designation here is Amranee, of the house of Amr, one being written with an Aieen, the other an Alif.

ried women should in the first instance be brought to him. Chota went to his brother, and sought to dissuade him from so infamous a practice; but all argument proved vain. At length, one day, when Chota was absent from home, the king proceeded to his brother's house. He had heard much in praise of Fatima, and longed to see her. But intelligence of the occurrence was quickly conveyed to the husband, who returned to watch his brother's actions in secret. Convinced of the baseness of the tyrant's purpose, he rushed from his hiding-place, rescued his young and virtuous wife from the grasp of her tempter, and instantly quitted the city. A voice said, 'This city is about to be swallowed up by the earth, owing to the wickedness of its ruler. Let him save himself who takes due warning.' A few obeyed, and were watchful. The first night the city was spared, by the wakefulness of an old woman at a wheel; the second by means of an oil-presser; the third night the city went headlong into the earth,—only one minaret was left, as an example."

7. In supposing the date of the destruction of Brahminabad to accord with the epoch inferred by the Tatta Syud, I should remark that Mahomed of Ghisnee annexed Sind to his dominions in about 1025. It is not at all likely that this conqueror would have left standing so powerful a subject as King Diloo Raee, whose territory extended from Brahminabad even up to Dhera Ghazee Khan and Seelpoor; for the children of Saif-ool-Mulek, the merchant, and his wife Badeea-ooz-Zemain (whose treatment by Diloo Raee was cause of the ruin of Alore) are said to have been buried in the above locality "in the king's dominions." If Syud Ali Moosooee, then, accompanied Chota on his return from Bagdad in 1020, the destruction of the city may be supposed to have almost immediately followed their arrival in Sind.

ART. VII.—*Researches and Discoveries in Assyria and Babylonia.* By Sir H. C. RAWLINSON, K.C.B., K.L.S., &c.

July 1855.

COLONEL RAWLINSON having been solicited to communicate to the meeting a brief description, *vivâ voce*, of the results of recent discovery in Assyria and Babylonia, proceeded to comply with the request. He pointed out, however, at the commencement of his address, that the subject was too large to be handled with effect within the limit of time allowed to him; that it was impossible to follow out an inquiry which involved the restoration of the history of Western Asia from the Patriarchal ages to the time of Cyrus in a single hour's discussion—and that he should therefore confine himself to the mere heads of the arguments in general matters; reserving all particular description for those salient points where cuneiform research came in contact with scripture history, and where the means were thus afforded of illustrating and verifying the inspired writings of the Jews.

He exhibited on the table a collection of antiquities, which he had lately obtained in Chaldea, Assyria, and Babylonia, and which he was now conveying to England for deposit in the British Museum. They were arranged in three different classes, and were intended to illustrate three distinct periods of history. The most ancient class was Chaldean; the second was Assyrian; and the third was Babylonian. The Chaldean class consisted of relics found at the primitive capitals of Southern Chaldea, which are now represented by the ruins of *Mugheir* (Ur of the Chaldees), of *Warká* (Erech of Genesis), of *Senkereh* (Ellasar of Genesis), of *Niffer* (Accad) and the neighbouring sites. Among the relics were stamps of the cuneiform legends impressed on the bricks of the ancient palaces and temples, a number of inscribed cones of baked clay, and a small tablet of black marble, bearing a well-preserved legend in the ancient hieratic character; and the period to which the relics belonged was stated to extend from about the twentieth to the thirteenth century B.C. In proof of such antiquity, Colonel

Rawlinson referred to the brick legends of one of the Chaldean kings, *Ismi-Dagon* by name, and showed that by a series of dates, fortunately preserved upon the Assyrian monuments, the interval between this monarch and Sennacherib was determined to be above 1150 years, so that the former king must have ascended the throne of Chaldea in the early part of the nineteenth century B. C. But *Ismi-Dagon* was not the first monarch of his line. Relics had been obtained of several of his predecessors, one of whom was named *Kudur-Mapula*, "the ravager of Syria," and it was pointed out that this epithet naturally suggested an identity with the Chedorlaomer of scripture. The latter form indeed seemed to be a corruption of *Kuddur-el-Amar*, or "Kudur the Red," and to refer to the king's Semitic nationality, a conflict of races at that time having pervaded the East, and the Scythian or Cushite aborigines being termed "the black," while the Semitic invaders were distinguished as "the red." It was not thought necessary to follow the primitive Chaldean line in any detail, as the names were throughout unknown in history; but it was stated that a list had been obtained of above twenty of these monarchs from the various ruins on the lower Tigris and Euphrates, and hopes were held out that, as materials accumulated, all the names might be classified and connected, if not in a genealogical series, at any rate in a dynastic succession.

It was next explained that the second class of relics, consisting for the most part of tablets of "terra cotta," belonged to the Assyrian period, which extended from the thirteenth century B. C. to the capture of Nineveh in about B. C. 625, and that to this chronological division belonged all those specimens of Assyrian art which had recently attracted the admiration of Europe. There seemed no reason to doubt but that, during the long period of Chaldean supremacy, Assyria occupied a very subordinate place in the civil polity of the East. The primeval rulers of the country, whose names had been found impressed in rude characters on the bricks of the earliest Northern Capital (now called *Kileh Shergât*), had never assumed the regal title; nor among the territorial epithets, which the Chaldean monarchs catalogued on their monuments, was the expression "King of Assyria" to be met with. Works of art anterior to the thirteenth century B. C. were absolutely unknown upon the upper Tigris, and the inference therefore seemed to be that, although the Assyrians had imported from Chaldea in the very earliest times the use of letters and the rudiments of civilization, the country had not attained to any political consequence, until the Southern Monarchy had ceased to exist. At the same time it was not probable that the Assyrians, like

the Persians of a later age, had made a sudden stride from dependence to universal dominion. Of the early kings little had been preserved beyond the names; but we had fortunately the detailed annals of a monarch, named Tiglath-Pileser (the first), who ascended the throne at least 150 years after the foundation of the monarchy, and even at that late period Babylonia had not become subject to Assyria. On the contrary, *Merodach-adan-akhi*, the king of Babylonia, contemporary with Tiglath-Pileser I., had, in about B. C. 1110, attained a great victory over the armies of Nineveh, and had carried off the Assyrian gods as trophies to Babylon;—but the Assyrian arms, although checked to the south, had already penetrated to the north far beyond the range of Taurus, and to the west to the shores of the Mediterranean. The most interesting result, indeed, which was obtained from the annals of Tiglath-Pileser I., was the light thrown by that monarch's wars in Syria and Asia Minor on the ethnographical distribution of Western Asia in the twelfth century B. C. It appeared at that time that Northern Syria and the great plateau of Anatolia were peopled by Scythian nations, while Southern Syria was dependent upon Egypt (the Casluchim or Khasmonians, who, according to scripture, were the ancestors of the Philistines, being the dominant tribe), and the Aramæan stock was confined to the valleys of the Tigris and Euphrates. The Jews must have been then living under the rule of the Judges, and were probably confounded by the Assyrians with the other scattered Semite colonies, who ackowledged the Khasmonian supremacy.

The most brilliant period of Jewish history—that is, the age of David and Solomon—unfortunately admitted of no illustration from the Assyrian annals. The contemporary monarchs of Nineveh were occupied with the building of cities and the adornment of their palaces and temples, or with expeditions among the northern mountains, but they were hardly yet strong enough to provoke a contest with the organized armies of the kings of Syria. It was at the commencement of the ninth century B. C., shortly after the building of Samaria, that the Assyrians first undertook the subjugation of the countries on the Mediterranean; and from that period to the extinction of the empire, the annals of Nineveh, running in a parallel line with Jewish history, presented a series of notices, which established in the most conclusive manner the authenticity of the Hebrew scriptures. The geographical names which occurred in the Bible were also found in the inscriptions. The names of the kings of Israel and Judah, of Damascus and of Nineveh, were given in the two independent accounts under the same forms, in the same order of succession, and with the same chronological relations.

The same events even were described, with that mere variation of colouring which was due to national feeling.

In the earliest expedition into Syria of this period, that undertaken by *Asshur-uchur-bal*, the builder of the North-West Palace at Nimrod, early in the ninth century B. C., the Assyrians did not come in direct contact with the Jews, though they overran the whole country as far south as Damascus, and even exacted tribute from the maritime cities of Phœnicia. The succeeding king, *Silima-rish*, fought several battles with Ben Hadad, and, after the dethronement of the latter, with the usurper Hazael, while he also received rich presents from Jehu, who is called in the inscriptions the son of Omri from having sat on the throne of Samaria. The annals of the next king, *Shamasphul*, extended but to four years, during which the wars of the Assyrians were confined to Asia Minor and Babylonia; and of his successor, *Phulukh*, (the *Pul* of scripture and Φαλωχ of the LXX., no strictly historical record had been yet found. The interesting fact, however, had been discovered that this king married a foreign princess of the name of *Summuramit* (or Semiramis), and that, having lost his throne by a domestic revolution to a stranger of the name of Tiglath-Pileser (the second), the upper royal line of Assyria, after a dynastic rule of 526 years, terminated in his person—all this minutely agreeing with the fragments of Assyrian history preserved to us by the Greeks. From the death or dethronement of Pul commenced the second or lower Assyrian line, the epoch being marked in Babylonian history as the era of Nabonassor, and dating from B. C. 747. Of Tiglath-Pileser, the first king of the lower dynasty, annals had been found extending to his seventeenth year, and among his tributaries were many names which were of interest from scriptural association, such as Menahem of Samaria, Rezin of Damascus, Hiram of Tyre, the Kings of Byblos, of Casius, of Carchemish, of Hamath, and even a Queen of the Arabs, who seemed to have reigned in Idumea, or Arabia Petræa, and who is the representative in regard to race and station of the famous Queen of Sheba, who had visited Solomon about two and a half centuries before.

According to scripture history Tiglath-Pileser must have been succeeded by Shalmaneser, a name which had not yet been found in the inscriptions, but which had originally headed, it was believed, certain mutilated tablets recording the wars of an Assyrian monarch with Hoshea (?) king of Samaria, and with a son of Rezin of Damascus. It seemed probable that as Tiglath-Pileser II. had defaced the monuments of Pul, whom he supplanted, so Sargon, who was again of a different lineage and who gained the throne of Nineveh in B. C. 721, had designedly mutilated the records of Tiglath-Pileser and Shalmaneser,

who were his two immediate predecessors, no single slab belonging to these kings having been ever found, either in a perfect state or in its original position. The explanation offered of this period of history was that Shalmaneser had succeeded his father, Tiglath-Pileser, on the throne of Nineveh about B. C. 728,—that he laid siege to Samaria in 724-23, and while engaged in that operation was surprised by the revolt of Sargon, who ultimately drove him from power and established himself in his place in B. C. 721. Sargon's first act was to bring the siege of Samaria to a close, and the account of the Samaritan captivity given in the inscriptions corresponded closely with that preserved in scripture. Halah, Habor, indeed, and the river of Gozan, where the expatriated tribes were placed, and which had been so variously identified by geographers, were proved by the inscriptions to be represented by the modern *Nimrud*, and by the two rivers, the *Khaboor* and the *Mygdonius*, the latter Greek term being a mere participial formation of Gozan, which was the original Assyrian name of the city of *Nisibin*. The annals of Sargon were preserved in great detail, and were replete with notices of much historical interest. His wars were described, with *Merodach Baladan*, the king of Babylon, with the kings of Ashdod, of Gaza, of Hamath, of Carchemish, and of many other Syrian cities. He received tribute from Pharaoh of Egypt, from the Queen of the Arabs, and her confederate the chief of Sheba (or the Sabæans who at that period dwelt in Edom). There was a distinct account, moreover, of the expedition to Cyprus (which was referred by the Greeks to Shalmaneser); and Sargon's memorial tablet had been discovered in the Island. The history of Western Asia, indeed, at the close of the eighth century B. C., was given in the most elaborate detail in the inscriptions of Khorsabad, which was Sargon's capital, and in every respect was found to coincide with the contemporary annals of the Jews. Verifications of still more importance had followed from the discovery of the annals of Sennacherib, who succeeded his father Sargon in B. C. 702. His wars with Ilulœus of Sidon, and with Merodach Baladan and his sons, were in near accordance with the notices of the Greeks, and the famous Assyrian expedition, which Sennacherib led against Hezekiah of Jerusalem, as given in the native annals, coincided in all essential points (even to the numbers of the thirty talents of gold which the Jewish king paid as a peace-offering) with the scriptural record of the event. It was not to be expected that the monarch of Assyria would deliberately chronicle his discomfiture under the walls of Jerusalem and his disastrous retreat to Nineveh; but there was the significant admission in his annals that he did not succeed in capturing the Jewish capital, and this was sufficient to attest the interposition of a miraculous power.

The annals again of Esar Haddon, who ascended the throne on the death of his father, in about B. C. 680, were of almost equal interest. He warred in Phœnicia, in Syria, in Asia Minor, and Armenia, in Media, in Susiana, and in Babylonia. He sent a Queen from his own household to rule over the Arabs of Edom. He must have led a great expedition into Africa, for he assumed the distinctive title of "Conqueror of Egypt and Æthiopia." Finally he obtained the aid of Manasseh, king of Judea, together with that of most of the other kings of Syria, in constructing a magnificent palace at Calah, of which building the ruins are still to be seen at the south-west corner of the great mound of Nimrud.

The son of Esar Haddon, who was named *Asshur-bani-bal*, but who was almost unknown to the Greeks, had left numerous monuments and of great value. Mr. Layard had excavated, some years ago, a portion of one of this king's palaces at Nineveh, but recently a far more perfect and more highly finished building of the same king had been discovered in another part of the mound of *Koyunjik*. The sculptures in this palace were of the very highest class of Assyrian art. The hunting scenes, indeed, represented on the walls of some of the chambers, were perfectly beautiful both in design and execution, and a very large selection of these had been made for the Assyrian gallery in the British Museum. In illustration of this branch of the subject some figures of dogs in "terra cotta" were exhibited, which had been discovered in a cavity of the wall on removing the slabs which formed the wainscoting. They were models apparently of the favourite lion-hounds of the king, the figures being painted of different colours, and having other distinctive marks, while the name of each dog, generally a descriptive epithet, had been stamped or incised upon the clay.

The most valuable relics however of the time of *Asshur-bani-bal* were stated to be the inscribed clay tablets of baked clay forming portions of the Royal Library. The number of these tablets already exhumed could not be less than 10,000, and they appeared to embrace every branch of science known to the ancient Assyrians. They were especially valuable in affording explanations of the Assyrian system of writing, one class of them, unfortunately rarely met with, but of which a specimen was exhibited at the table, showing how the original pictorial figures had been degraded to characters, while others contained tables expressing the different syllabic values which were attached to each character, and a third class again presented elaborate lists of all the simple and compound ideographs of the language with their phonetic equivalents. Even with the important help of these explanatory tables the work of decipherment had proceeded slowly, and many

difficulties still remained to be overcome; but without their aid, it was observed, the inscriptions would have continued to the present time to be for the most part unintelligible.

It was now left for Colonel Rawlinson to refer to the Babylonian period of history, and to invite the meeting to examine the highly important and original relics of this period, which were laid out upon the table. The last king of Nineveh, *Asshur-ebid-ilut*, of whom nothing remained but a few bricks with half obliterated legends, had been probably dispossessed of his throne by the united armies of the Medes and Babylonians in about B. C. 625. Nabopolassar, who either sent or led the expedition against Nineveh, became from this period the lord paramount of Western Asia. The seat of his empire was at Babylon, which he strengthened and partially rebuilt. Many tablets had been found dating from different periods of his reign, but there was no autographic record, either of his domestic works, or of his foreign conquests. It was to his son Nebuchadnezzar, who succeeded him in B. C. 606, and who reigned for forty-four years, that most of the Babylonian relics belonged, which now filled the museums of Europe. A very interesting discovery had been recently made in regard to a building erected by this monarch, the particulars of which were described as follows :—

A remarkable ruin, named *Birs Nimrud*, and situated on a mound in the vicinity of Babylon, had long been an object of curiosity to all travellers and antiquaries. The great height of the mound, its prodigious extent, and its state of tolerable preservation, contrasting so favourably with the shapeless heaps in the neighbourhood, had very generally suggested the identity of the ruin with the temple of Belus, so minutely described by Herodotus, and as there were large vitrified masses of brickwork on the summit of the mound, which presented the appearance of having been subjected to the influence of intense heat, conjectures that the *Birs* might even represent the ruins of the tower of Babel, destroyed by lightning from heaven, had been not unfrequently hazarded and believed. To resolve the many interesting questions connected with this ruin, Colonel Rawlinson undertook, last autumn, its systematic examination. Experimental trenches were opened in vertical lines from the summit to the base, and wherever walls were met with they were laid bare by horizontal galleries being run along them. After two months of preliminary excavation, Colonel Rawlinson visited the works, and, profiting by the experience acquired in his previous researches, he was able in the course of half an hour's examination to detect the spots where the commemorative records were deposited, and to extract, to the utter astonishment of the

Arabs, from concealed cavities in the walls, the two large inscribed cylinders of baked clay which were exhibited to the meeting, and which were now in as fine a state of preservation as when they were deposited in their hiding place by Nebuchadnezzar above twenty-five centuries ago. From these cylinders it appeared that the temple had been originally built by the king *Merodach-adan-akhi* at the close of the twelfth century B.C., and probably in celebration of his victory over Tiglath-Pileser I.; that it had subsequently fallen into ruin, and had been in consequence subjected to a thorough repair by Nebuchadnezzar in about B.C. 580. The curious fact was further elicited, that it was named the "Temple of the Seven Spheres," and that it had been laid out in conformity with the Chaldean Planetary system, seven stages being erected one above the other according to the order of the seven planets, and their stages being coloured after the hue of the planets to which they were respectively dedicated. Thus the lower stage belonging to Saturn was black; the second sacred to Jupiter was orange; the third or that of Mars was red; the fourth of the Sun, golden; the fifth of Venus, white; the sixth of Mercury, blue; and the seventh of the Moon, a silvery green. In several cases these colours were still clearly to be distinguished, the appropriate hue being obtained by the quality and burning of the bricks, and it was thus ascertained that the vitrified masses at the summit were the result of design and not of accident—the sixth stage sacred to Mercury having been subjected to an intense and prolonged fire, in order to produce the blue slag colour, which was emblematic of that planet. It further appeared, that we were indebted to this peculiarity of construction for the preservation of the monument, when so many of its sister temples had utterly perished, the blue slag cap at the summit of the pile resisting the action of the weather, and holding together the lower stages, which would otherwise have crumbled, while it also afforded an immovable pedestal for the upper stage and for the shrine which probably crowned the pile. The only other point of interest which was ascertained from the cylinders was that the temple in question did not belong to Babylon, but to the neighbouring city of Borsippa, the title of *Birs* by which it is now known being a mere abbreviation of the ancient name of the city.

Colonel Rawlinson now adverted to the famous slab of Nebuchadnezzar which is deposited in the Museum of the India House; and he stated that it contained a description of the various works executed by Nebuchadnezzar at Babylon and Borsippa, which so nearly corresponded with the account of Berosus quoted by Josephus, that it would hardly be doubted the Chaldee historian had consulted the original

autographic record; and here was introduced the notice of a most remarkable passage of the India House inscription, which seemed to contain the official version adopted by the king of that terrible calamity that overtook him in the midst of his career. Abruptly breaking off from the narrative of the architectural decoration of Babylon, the inscription denounced the Chaldean astrologers; the king's heart was hardened against them; he would grant no benefactions for religious purposes; he intermitted the worship of Merodach, and put an end to the sacrifice of victims; he laboured under the effects of enchantment (?). There is much that is extremely obscure in this episodical fragment, but it really seemed to allude to the temporary insanity of the monarch, and at its close, when the spell was broken which had been cast over him, the thread of the argument, having reference to the building of Babylon, was resumed. There was a passing allusion in this inscription to the Western conquests of Nebuchadnezzar, and in an amplified copy upon a clay cylinder, of which a fragment had also been found at the *Birs*, the subjugation of the countries on the Mediterranean was specifically mentioned; but hitherto annals of the Babylonian monarchs, similar to those which were so carefully prepared in Assyria, had in no instance been discovered, and an independent account therefore of the capture of Jerusalem and the carrying away the Jews into captivity was still among the desiderata of cuneiform science.

After a brief notice of Nebuchadnezzar's successors, *Evil Merodach* and *Nergal-shar-ezer* (Neriglissar of the Greeks), Colonel Rawlinson proceeded to explain his last discovery of importance, which established the fact of the eldest son of Nabonidus having been named *Bel-shar-ezer*, and that pointed the way to the reconcilement of Profane and Sacred History in regard to the capture of Babylon by Cyrus. Relics of Nabonidus, the last king of Babylon, abounded, not only at Babylon and Borsippa, but in Southern Chaldea also. From the ruins of a temple to "the Moon," which had been recently excavated at "Ur of the Chaldees," four perfect cylinders of this king had been recovered, which were now placed on the table, together with the fragments of a hollow barrel cylinder of the same period. The latter relic contained a detailed account of the various works of Nabonidus throughout the empire, and was particularly valuable in mentioning the monarchs who founded and repaired the temples in the different capitals, and in establishing their chronological succession. The four smaller cylinders, which all bore the same inscription, referred particularly to the history of the temple of "the Moon" at Ur of the Chaldees. In both legends the architectural description was finished

with a special prayer and invocation for the welfare of the king's eldest son *Bel-shar-ezer ;* and as this substitution of the name of the king's son for that of the king himself was an isolated example and totally at variance with ancient usage, the only reasonable explanation of it seemed to be that *Bel-shar-ezer* (abbreviated in Daniel to *Belshazzar,* as *Nergal-shar-ezer* was shortened by the Greeks to Neriglissar) had been raised by the king during his lifetime to a participation in the imperial dignity. On this supposition then—that there were two kings reigning at the same time in Babylon,—it could well be understood that Nabonidus, the father, may have met the Persians in the open field, and after his defeat may have thrown himself into the stronghold of Borsippa as stated by Berosus ; while Belshazzar, the son, may have awaited the attack of the enemy in Babylon, and have fallen under that awful visitation of the divine vengeance which is described in the Book of Daniel. That the eldest son of Nabonidus, indeed, who is distinctly named *Bel-shar-ezer* in the cylinders of *Mugheir,* could not have survived the extinction of the empire is rendered certain by the fact that when a revolt of the Babylonians took place at the commencement of the reign of Darius Hystaspes, the impostor who personated the heir to the kingdom and called his countrymen to arms, assumed the name of " *Nabukudruchur,* the son of Nabunit" (see inscription of Behistun), the rights of the eldest son having descended to the second. As the cylinders exhibited to the meeting were the only solitary documents on which the name of Belshazzar had been ever found, apart from the pages of Daniel, they were objects of special interest, and would no doubt be reckoned among the choicest treasures of the British Museum.

Colonel Rawlinson had not at present in his charge any relics of a later period, though he stated that tablets dated during the reigns of the Achæmenian monarchs from Cyrus to Darius Coddomanus, were by no means rare, and that he had even recently examined a number of cuneiform documents, consisting of benefactions to temples, which were dated under the reigns of Seleucus and Antiochus.

Among the miscellaneous articles exhibited were a number of signet cylinders, which were commonly used by the Babylonians as seals to authenticate official documents. All the benefaction tablets recently discovered were thus endorsed, having been impressed while the clay was soft. The legends however on the cylinders were of no consequence, merely consisting of the name of the owner, of that of his father, and of an epithet implying dependence on one of the numerous gods of the Pantheon. A black stone, bearing the symbols of the gods, and invoking their vengeance on any one who should alter or resume a certain grant of lands recorded in the document, was also on the table.

It was stated to be very similar to the relic usually known in Europe as "le caillon de Michaud," another mutilated specimen of the same class which was obtained from Babylon by Mr. Rich being already in the British Museum, and being in fact the identical stone with which some years ago the famous Portland vase was dashed to pieces. The only other object of interest was a small cube of ivory, bearing on it certain mathematical tables, which were inscribed however in a character so minute as to be almost invisible until examined with a strong magnifying glass, and it was suggested that from this specimen alone we might reasonably believe the Assyrians to have been in the habit of manufacturing lenses, and to have been thus considerably advanced in a knowledge of the science of optics!

Colonel Rawlinson having been further requested, by Dr. Wilson, to say a few words on the subject of the language of the inscriptions and the mode of decipherment, explained, that the first clue to the reading of the Assyrian character was obtained from the tri-lingual rock-tablets of Persia and especially from the autographic record of Darius Hystaspes at Behistun. As a translation in the Babylonian character and language, which nearly resembled the Assyrian, was appended to the original Persian edict at the latter place, the sense of the one being known, a sure basis was established for the analysis of the other. His comparison of the two versions of this inscription and his preliminary researches into the grammar and etymological affinities of the language of ancient Babylon, had been published in the Journal of the Royal Asiatic Society some four years back, and as he had since that time studied and analyzed many thousand inscriptions, not mere rock legends of a few lines restricted to the formula of royal proclamation, but long elaborate histories, records of the chase, architectural reports, scientific treatises, prayers, invocations, and the whole arcana of the Chaldee religion and philosophy, he might now really claim a very extended acquaintance with the language. In all essential points the Babylonian was a mere primitive Hebrew—the roots were the same,—the grammatical construction perfectly analogous—the conjugations very similar,—the names of objects for the most part identical. The radical difficulty in reading and understanding Babylonian and Assyrian lay in the extraordinary number of the characters employed (the phonetic signs alone exceeding 300); in their variant powers, one character being often used to express six or seven different syllabic sounds; and above all in the very general employment both of simple and compound ideographs, of which, although the meaning might be ascertained from the context, it was impossible to define the phonetic values without the aid of the explanatory tablets. From the

latter source he had now succeeded in tabulating between 3 and 4000 ideographs with their phonetic correspondents, but he did not consider this branch of the subject to be one half exhausted. His own impression was that there were at least 20,000 ideographs in common use, and he considered that until these were all determinately explained and read, no one could pretend to have thoroughly mastered the language. He was now proceeding to England in the hope that he might advance the work of decipherment, and should steadily pursue the inquiry through his future life.

Colonel Rawlinson, in conclusion, expressed his obligations to the Society for the aid which he had received from it in his early studies, and especially by its extensive library, to which he was under great obligations. He had peculiar satisfaction in appearing before it on this occasion, on observing the parties by whom he was surrounded. To a distinguished friend of his Lordship in the chair, bearing the honoured name of "Elphinstone," he was greatly indebted. That friend had received him on his first arrival in India, and had greatly encouraged him in his study of the eastern languages, to which any success which he had experienced was much to be ascribed.

The Rev. Dr. Wilson, Honorary President of the Society, rose for the purpose of moving that its best thanks be conveyed by the Patron of the Society, Lord Elphinstone, to Colonel Rawlinson, for his most able and interesting communications on this occasion; and that the Secretary should be directed to prepare a minute expressive of the regard which it cherishes for this distinguished member, whom it congratulates on the unparalleled success of his learned investigations. Colonel Rawlinson, he added, had expressed his obligations to the Society, and especially to its library, for the aid which they had furnished him in his lingual and historical studies. But these advantages must not be over-estimated. Without Colonel Rawlinson's peculiar talent in the acquisition of the oriental tongues, his readiness and acuteness of observation, and his patience and perseverance of research, they would have been of no avail in effecting the great results which had awakened the attention and secured the confidence of the scholars of Britain, France, Germany, and America, and which had excited the wonder and admiration of less competent judges throughout the world. He had certainly received no assistance from his contemporary members of the Society, except in the general sympathy which is common to them and intelligent observers everywhere to be found. It is to the honour of the Society, however, that Mr. Rich, one of its early members, who was much encouraged by the counsel of its founder, Sir James

Mackintosh, had taken the lead in Assyrian and Babylonian research, exploring the ruins of Babylon and Nineveh, and making large and valuable collections of their minor antiquities ; and that its Transactions contained an analysis and review by Mr. Bellino, another of its members, of the first *tentamina* for the decipherment of the cuneiform inscriptions of Dr. Grotefend and his predecessors ; and that Dr. Grotefend himself had duly informed it of his own discoveries, as from time to time they advanced. Colonel Rawlinson was the party to whom the praise was due of bringing all the researches on the cuneiform inscriptions of those who had preceded him to a fruitful issue, and of making such advances in this study as required the greatest effort of the most learned orientalists to follow him. Dr. Grotefend, by attending to the groupings of the wedges in the Persepolitan and adjacent inscriptions, had been able to point out the forms of distinct letters and their composition in words separated from one another by a slanting bar. The phonetic powers of some of the letters he had ascertained, by making trial of their application to the names of the Persian sovereigns. The meaning of a few titles attached to these sovereigns he had also ascertained. The distinguished linguist and archæologist, Professor E. Burnouf, of Paris, whose death was so much and generally regretted, and Professor Lassen, of Bonn, one of the greatest orientalists and antiquaries of the present day, had greatly extended the knowledge of the ancient Persian alphabet, and made some of the cuneiform inscriptions intelligible, from their wonderful attainments in the Indo-Persic languages. But Colonel Rawlinson had accurately transcribed and published the tri-lingual inscriptions of Behistun, in the Persic, Babylonish, and Scythian cuneiform. He had completed the identification of all the letters of the Persian cuneiform, establishing the precise value of those formerly unknown or mistaken. He had translated the biography of the Achæmenian kings as recorded by themselves. From a comparison of the Persian inscriptions with those in the Babylonish character, he had ascertained the import of the latter, and prepared the way for the decipherment and translation of the Scythian inscriptions by Mr. Westergaard, and more particularly by Mr. Norris of the Royal Asiatic Society. He had found that the later Babylonish cuneiform letters were only a cursive corruption of the Assyrian cuneiform, and thus got the key to the Nineveh tablets, obelisks, and cylinders, the wondrous stories of which he had in substance unfolded to the world, awaiting a more particular literary exposition of them than public duty had yet permitted him to make. The most ancient Chaldean writings had not been able to baffle his ingenuity ; and the Society had witnessed, in the course of his familiar

address this day, how he was able to deal with them. His acquisition of antiquities at Nineveh and its adjacent sites reflected honour on the British nation, even after the success of Botta and Layard. What he had lately effected in Babylon and Chaldea, as illustrated by the interesting relics on the table, was most wonderful. It is impossible to over-estimate the importance of the researches in which he has been engaged, and in which he has been so successful. The great fact, that they went so far as they did to corroborate and illustrate the Hebrew scriptures, tended much to the confirmation and extended appreciation of those historical records which, originally written by the pen of inspiration, were so dear to all our hearts. The statement which he had made respecting the language of the most ancient Chaldean relics, even, was of the greatest importance. He (Dr. Wilson) conceived he could easily make by it an explanation of various Chaldeanisms in the earlier books of the bible, which by some incautious and unwary critics had been pointed to as neonisms, while, in fact, they are nothing but archaisms, such as would be used, especially in poetical pieces, by the family of Abraham, who was himself from Ur of the Chaldees. Colonel Rawlinson's researches, combinedly viewed, throw a flood of light on the history, art, science, and religion of the ancient world. Well worthy is he of all the honours which he has already received, and which doubtless await him in Europe, which he is about to visit.

Though the highest tribute of applause which this Society could extend to him was of small value, yet, as it was offered with sincerity and cordiality, it might be accepted.

Dr. Wilson's motion, having been seconded by Major General WADDINGTON, C.B., one of the Vice-Presidents of the Society, was unanimously and cordially adopted.

THE RIGHT HONORABLE LORD ELPHINSTONE, Patron of the Society, who presided on this occasion, stated that he had the greatest pleasure in conveying the thanks of the Society to Colonel Rawlinson in the terms of the motion now adopted, and of expressing his own thanks for the singular gratification afforded by his address this evening.

ART. VIII.—*On the Avesta, and the Zend and Pahlavi Languages.* By Professor SPIEGEL, in a Letter to the Rev. J. MURRAY MITCHELL, Bombay.

Read October 1855.

*Erlangen, the 17th May* 1855.

MY DEAR SIR,—I am extremely sorry that I have been compelled to defer so long the letter I promised to send you more than a year ago. My health, thank God, has been good all the while and is very likely to remain so, on this account I cannot answer for my prolonged silence. The fact is that I had made to you, in my last letter, a too rash promise which I could not fulfil before now. I had pledged myself to give you a short account of my studies in the Persian languages, and I was of the opinion then that I could do so within a few months. On nearer inspection, however, I perceived that my own studies would require more time than I first expected; and yet I was the more unwilling to break my former promise, as I hoped my results would be of some interest to you. Now, when I have completed a Pahlavi grammar and have a short history of Pahlavi literature nearly ready, I will not longer delay to answer your honoured letter of the 15th January. * * * * *

As you know, I was first induced to my promise by some remarks on the Persian languages by Mr. Romer, of which Mr. Romer did me the honour to transmit several copies, without, however, giving me his address. * * * * I shall not, however, enter on any discussion with Mr. Romer, owing to the difference of our principles. The rules of comparative grammar, which are laid down in the well-known works of Professor Bopp, he seems not to acknowledge; and yet they form the basis of the researches of M. Burnouf and Colonel Rawlinson as well as of my own. Laying therefore aside all polemical reasoning, I shall only endeavour to make my own views on the languages of Persia and their relations to each other as clear to you as it is possible

for me according to the present state of my researches. I shall begin with the oldest of them—the old Persian or the Zend, as it is commonly called. All the Oriental scholars agree that there exists a close affinity between the old Persian, the Zend—or, as I am inclined to call it, according to M. Oppert's proposition, the old Bactrian—and the Sanskrit; and the only difference exists with reference to the antiquity of the old Bactrian. Professor Burnouf takes it to be a very old language, and maintains that not the language only but even the literary productions of the Pársís in it belong to a time not so much later than that in which the language of the Vedas was spoken. Burnouf's opinion has been adopted by almost all the Continental scholars. Colonel Rawlinson, on the contrary, assures us that Burnouf's arguments have altogether failed to convince him of the close affinity between the Vedic Sanskrit and the old Bactrian, and he maintains that the Achæmenian dialect is the parent of the language of the Avesta. For my own part, although I do not deny that there are fragments of very old writings incorporated in the Avesta, I am inclined to side with Colonel Rawlinson in so far that I presume the Avesta to have been written down, as a whole, in a period much later than the reign of Xerxes or Darius. The comparative purity of the language is easily accounted for, for it is a well-known fact that language degenerates by long usage, and that literary pursuits have by no means a favourable influence on the language itself. Now the old Bactrians were, as Strabo testifies, but little better than Nomads, and therefore by no means a literary nation. The art of writing was entirely unknown, or at least very little used, in Bactria; in the old times, before the invasion of Alexander, all the literary compositions were retained by memory. In the Avesta itself writing is never mentioned, but it is always enjoined to keep the single parts of it in memory and to recite them. Therefore I think the Avesta must have been written down at a comparatively late period, after the invasion of Alexander.

If I differ, as you will perceive, with regard to the age of the Avesta, as a whole, from the greater part of the learned Orientalists, I do not deny that a good many parts of the book are old, and must have been current a considerable time before they were committed to writing. In many and essential points the precepts of the Avesta entirely agree with the manners and institutions of the old Persians as related to us by the classical writers. Only one must not expect that everything should be alike. The fatherland of the Avesta, as is generally believed for weighty reasons, is to be sought for in the neighbourhood of Bactria, and the difference of the country accounts for the difference of religious and

political institutions, even if these, taken as a whole, were nearly the same.

At what time and how these religious writings of the old Bactrians first extended their influence beyond their native boundaries, and were accepted as the sacred writings of the western part of Persia, I cannot tell, as we cannot derive even the feeble outlines of a history of the old Persian religion from contemporary and trustworthy sources. But it is a well-known fact, that the Avesta was generally accepted as a sacred work over the whole Persian empire in the time of the Sasanian kings. The old Bactrian language we just spoke of was by that time a dead language. We find that the Avesta has been translated into one of the languages of those times; and this language still exists and has formed the principal topic of my studies during the last two years. The Pahlavi language has been considered, as you well know, as a forgery by many learned men; and this opinion is not wholly without foundation, but certainly much exaggerated. That the identical language, which is found in the writings of the Pársís, has really been in use for some time, cannot be doubted in our times. A large number of coins, which have been so assiduously collected and so skilfully explained by such men as Olshausen, Thomas, and Mordtmann, bear undoubtedly inscriptions in the same language in which the translation of the Avesta is written. The coins I mean are those of the later Sasanian kings. In the times of these kings, then, the Pahlavi language must have been a spoken language; and to these times I refer it. It might be objected, that the mixture with Arabic words, which are said to occur in the Pahlavi writings, is not likely to have taken place so early. But I must own that I never have been able to find out any Arabic word in the genuine old Pahlavi writings, viz. the translations of the Vendidad and the Yaçna. The Arabic words referred to by Richardson and others are taken from a small glossary printed in the second volume of Anquetil's translation of the Avesta. There, undoubtedly, many Arabic words are given us as Pahlavi words, but they were never used in Pahlavi literature, and have come even into this glossary by mere inadvertence. Anquetil wrote the said glossary from dictation of his teachers in three columns, first the Zend word, afterwards the Pahlavi, and lastly the meaning of the latter in Persian or Arabic. By mere inadvertence he has sometimes put the Persian or Arabic meaning in the place of the Pahlavi word itself, and to this circumstance alone the occurrence of Arabic words is to be attributed. In removing the Arabic words we remove at the same time the principal reason for doubting the authenticity and the age of the language. The similar

words which very frequently occur in Pahlavi belong to an Aramaic dialect, and that the Aramaic was spoken in the times of the Sasanian kings and understood by themselves is a well-known fact. Nor is it an argument against the authenticity of the Pahlavi, that the Iranian words in it, as well as the grammatical structure itself, are so very like to the Persian. A large number of Persian words, gleaned from the earlier Armenian authors, show satisfactorily enough that, so early as the third century of our era, the Persian language was nearly on the same level with the language of Firdosi.

But notwithstanding all this, I am not of the opinion that the Pahlavi language was ever spoken in the form we have it before us. Aramaic words could never be mixed in that manner in any living language. It is merely the language of books, and, as I suspect, the official style in the edicts of the later Sasanian kings. Aramaic words were then mixed with Persian even in a larger degree than in modern Persian or in the edicts of Turkish emperors.

We are not wholly without means to determine in what country this memorable language had its origin. I have quoted all the authorities at full length in my book; here I shall only give the results. The author of the Fihrist-ul-Kutub, a very valuable encyclopædia, which contains many extracts from early Mahommedan writers now lost to us, states, on the authority of Ibn Mokaffa (who has translated the Fables of Bidpai into Arabic, and was himself a convert from the Pársí religion to Islam), that the inhabitants of Sevád (a country nearly coinciding with the modern Irak-arabi) used in their correspondence a kind of style where Persian and Syriac were mixed together. Ibn Mokaffa, as well as Parsí authorities, agree that the Huzvaresh (the name they commonly give to the language called by us the Pahlavi language) is used in the country of Sevád. This country was inhabited by a mixed population, partly Persians, partly Nabatæans. (The Nabatæans spoke a corrupted Aramaic dialect.) Both languages, the Aramaic and the Persian, were therefore known to the people of that country; the Aramaic was, moreover, the medium by which the literary and commercial communications of Persia with the western provinces were maintained. The Aramaic literature was highly esteemed in Persia during the reign of the Sasanians, and the literature of the Nabatæans had a prominent share in it, as you can see from the excellent memoir inserted by M. Quatremère in the *Journal Asiatique* for 1835.

The statements I have just made are fully confirmed by the Pahlavi literature itself. The Semitic words of the Pahlavi not only belong to

the Aramaic tongue but also to the eastern branch of it (to which the Nabatæans belonged, according to the testimony of Barhebræus and other Syriac grammarians), that is to say, they made no discrimination between the single gutturals and several of the dentals. The translations of the Avesta belong to the same class of writings as the Aramaic Targums or the Philoxenian translation of the Bible. This fact I hope to establish beyond all doubt; nor have we any right to be astonished at it, for the Persians, as you well know, were in the habit of visiting the Syriac Academy at Edessa and got all their learning from the Syrians.

After the downfall of the Sasanian empire, not only the old Persian religion declined, but the high authority of Aramaic learning also ceased, and was soon supplanted by the Arabic tongue and literature. The bulk of the Persian nation was converted to Islamism, and even the few Pársís who remained in Persia forgot by degrees the spelling of the Aramaic words, and, only anxious to retain the signification of the word, they pronounced the Persian word instead of the Aramaic one. For instance, if they found written in their text the Aramaic word *lahma*, "bread," they pronounced *nân*, the Persian synonym for it. By this fact is explained how the Pársís could ever forget the right spelling of the Aramaic words in Pahlavi. It is again Ibn Mokaffa who makes us aware of the proceeding just mentioned.

What I have stated to you here are merely the results of my studies in Pahlavi during the latter years. To quote the authorities on which they are based would exceed the compass of a letter; I must refer you to the book itself, which will, as I hope, be published soon, and where you will find all the proofs. * * * *

The new work on the Pahlavi language and literature I just spoke to you of has enticed me for some time from other studies, and has delayed the completion of my edition and translation of the Avesta. Since it is finished, I am at work again. The whole of the Vispered and more than half of the Yaçna are ready for the press, both the text and the translation; and I hope the second volume of the text and the translation will come out from the press in the beginning of next year. As to an English translation, I am not quite decided yet. My bookseller has declined to take part in the undertaking, and I think it would be indispensable, for many reasons, to have the work printed at Vienna. Besides, Mr. Westergaard, who has now completed his edition of the text, promises an English translation of it, and it is perhaps best to wait for it. * * * *

ART. IX.—*Review of the Present State of Oriental, Antiquarian, and Geographical Research connected with the West of India and the adjoining Countries.* By JOHN WILSON, D.D., F.R.S., Honorary President of the Society.

Read November 22nd, 1855.

THE first of our Asiatic Societies, and the model on which they are all constituted, was that of Bengal, formed in 1784, by the prince and pioneer of British orientalists, Sir William Jones. The happy idea of its institution occurred to him before he had planted his feet on these eastern shores. "When I was at sea last August," he said in his opening address, "on my voyage to this country, which I had long and ardently desired to visit, I found one evening, on inspecting the observations of the day, that India lay before us, and Persia on our left, whilst a breeze from Arabia blew nearly on our stern. A situation so pleasing in itself, and to me so new, could not fail to awaken a train of reflections in a mind which had early been accustomed to contemplate with delight the eventful histories and agreeable fictions of this eastern world. It gave me inexpressible pleasure to find myself in the midst of so noble an amphitheatre, almost encircled by the vast regions of Asia, which has ever been esteemed the nurse of sciences, the inventress of delightful and useful arts, the scene of glorious actions, fertile in the productions of human genius, abounding in natural wonders, and infinitely diversified in the forms of religion and government, in the laws, manners, customs, and languages, as well as in the features and complexions of men. I could not help remarking how important and extensive a field was yet unexplored, and how many solid advantages unimproved; and when I considered with pain that in this fluctuating, imperfect, and limited condition of life, such inquiries and improvements could only be made by the united efforts of many who are not easily brought, without some pressing inducement or strong impulse, to converge in a common point, I consoled myself with a hope, founded on opinions which it might have the appearance of flattery to mention,

that, if in any country or community such an union could be effected, it was among my countrymen in Bengal, with some of whom I already had, and with most was desirous of having the pleasure of being intimately acquainted." This distinguished man devised a wide sphere of observation and research for the Society which he thus projected. "It is your design, I conceive," he said, "to take an ample space for your learned investigations, bounding them only by the geographical limits of Asia; so that, considering Hindustan as a centre, and turning your eyes in idea to the north, you have on your right many important kingdoms in the eastern peninsula; the ancient and wonderful empire of China, with all her Tartarian dependencies; and that of Japan, with the cluster of precious islands, in which many singular curiosities have too long been concealed. Before you lies that prodigious chain of mountains which formerly, perhaps, were a barrier against the violence of the sea; and beyond them the very interesting country of Tibet, and the vast regions of Tartary, from which, as from the Trojan horse of the poets, have issued so many consummate warriors, whose domain has extended at least from the banks of the Ilissus to the mouths of the Ganges. On your left are the beautiful and celebrated provinces of Iran or Persia, the unmeasured and perhaps unmeasurable deserts of Arabia, and the once flourishing kingdom of Yemen, with the pleasant isles that the Arabs have subdued or colonised; and further westward the Asiatic dominions of the Turkish Sultans, whose moon seems approaching rapidly to its wane. By this great circumference the field of your useful researches will be enclosed; but since Egypt had unquestionably an old connection with this country, if not with China; since the language and literature of the Abyssinians bear a manifest affinity to those of Asia; since the Arabian arms prevailed along the African coast of the Mediterranean, and even erected a powerful dynasty on the continent of Europe, you may not be displeased occasionally to follow the streams of Asiatic learning a little beyond its natural boundary. And if it be necessary, or convenient, that a short name or epithet be given to our Society, in order to distinguish it in the world, that of ASIATIC appears both classical and proper, whether we consider the place or the object of the Institution, and preferable to Oriental, which is in truth a word merely relative, and though commonly used in Europe conveys no very distinct idea. If now it be asked, What are the intended objects of our inquiries within these spacious limits? we answer, Man and Nature; whatever is performed by the one or produced by the other."*

* Asiatic Researches, vol. i. pp. 9—13.

At the formation of our own Bombay Society in 1804, Sir James Mackintosh, its distinguished founder, took a more limited view of its intended operations; but his desires in connection with it gradually expanded till they embraced the eastern world in all its amplitude, in so far as its varied regions and multifarious tribes and tongues and natural productions might fall under the observation of its members. Sir John Malcolm in 1812 strikingly expressed the peculiar advantages of our position in Bombay for oriental research. "The field on which this Society has to labour, though it may appear small, will be found most productive. More approximated than any other part of British India to the shores of Arabia and Persia, and enjoying a more frequent intercourse with their inhabitants, the source of all knowledge connected with the Mahomedan religion and usages is more near and accessible. The borders of Gujarát and the deserts of Jaudhpor present most extraordinary races of men to your observation; among whom many singular customs in their manners, if not in their worship, may be discovered; and there is no place in India more favourable than this to the researches of the antiquarian and oriental scholar. The caves of Elephanta, of Salsette, of Kárla, and Ellora, are all in its vicinity; and these, with the ruins of Ahmadábád and other cities of former celebrity in Gujarát, offer an inexhaustible source to the curious and learned inquirer. The city of Bombay itself (I here speak from experience) presents, from its numerous population and the various persons who resort to it from every quarter, a great store of information (to those that seek it) on almost all subjects connected with the history, geography, and actual condition of the different kingdoms of Asia.* It is not only from its commercial prosperity that such persons resort to it, but from its being the port to which all the inhabitants of Arabia, Persia, Mekran, and part of Afghanistan, that visit India first come, as also that by which all pass that either go from India to these countries, or who proceed on a pilgrimage to Mecca, Kerbelah, or Nijif. In the whole course of my inquiries regarding the present state of the different provinces of Persia, Arabia, Afghanistan, Tartary, and even China, I have always been able to find a person in this city that was either a native of, or had visited the country regarding which I desired information. Independent of all these, the Gabars or Pársís (a complete account of whom is still a desideratum) are only to be met with in Bombay and its dependent provinces."*

To a great extent our Society has done justice to its position, though

* Bombay Transactions, vol. iii. Appendix.

the subjects which, in the progress of research, still demand its attention seem more numerous and extensive than ever. With the sister society in Bengal, and with the societies of more recent origin, but more extensive and able literary membership in England, France, and Germany, it has prosecuted with an encouraging degree of success the objects of its formation. The three quarto volumes of its Transactions, its considerable contributions to the Royal Asiatic Society of Great Britain and Ireland, and the four volumes of its own Journal, are highly valued, and have not been without their use in the general literature of our country. The distinctive and separate works of its members, published on individual responsibility, are of still higher interest and importance; and they are not to be dissociated from the Society in our estimate of its influence. By its library, the best in Asia, though it has still many obvious deficiencies even in those departments in which it should most excel, and by the generous fellowship and intercommunion and correspondence of its members, it has aided its associates both in their general culture and particular studies. It is our object at present briefly to note the research and authorship with which of late years it has been both directly and indirectly connected, and that principally with a view to our marking the subjects which now seem most to require our immediate notice in connection with the oriental research and literary labour of those in other parts of the world with whom it is an honour for us to act as willing, though, it may be, humble, coadjutors. I leave the proceedings of nearly the first forty years of the Society at present out of view, for to these I have adverted in detail on former occasions.* The operations of the last twelve years are those in particular to which, for a few minutes, I would respectfully beg to direct the attention of the zealous and enlightened patron of the Society and the members who are present on this occasion.

I begin with the literature of the Zoroastrians. Sir John Malcolm's remark on the Párs'ís was made before the publication of his own important work on the History of Persia, and the valuable and able papers on the Párs'ís and their Sacred Books by Mr. Erskine, which appear in our Transactions. On leaving India in 1843 I took the liberty of dedicating to the office-bearers and members of the Society a work entitled, "The Párs'í Religion: as contained in the Zand-Avastá, and propounded and defended by the Zoroastrians of India and Persia, Unfolded, Refuted, and Contrasted with Christianity." Though the

* See address to the Society, 27th January 1836, and Letter to the Secretary in the Journal of the Society, vol. i. pp. 234, et seq.

volume, from the circumstances in which it originated, it is to a great extent controversial in its form, I have had no reason to complain of the reception which it has experienced at the hands of our European orientalists. Its value in their eyes, whatever it has been, has doubtless been much enhanced by the contributions to its appendix of Messrs. Eastwick and Aganur. As it was passing though the press, I printed a small edition in Persian of the Zarthust-Námah, or Legendary Life of Zoroaster, which the former of these gentlemen had kindly rendered into English at my request.* Synchronously with it, too, the printing was going on, under my own eye, of the Vandidád, Yaçna, and Vispard of the Avastá, in the Zend language but Gujarátí character, and with a Gujarátí Translation, Commentary, and Paraphrase, by the late Frámjí Aspandiárjí and other Dasturs. The manuscript of this work, in five considerable volumes, I had purchased at Daman from the late Fardunjí Meherazbánjí, in 1835, for about Rupees 500; but the expense of lithographing a small impression of it, amounting to some two or three thousand rupees, was, on the suggestion of Drs. Buist and Malcolmson, entirely defrayed by the Society. Though by no means of an authoritative character,—for it is founded more on traditional than philological principles,—it has been esteemed a boon by the learned societies and individuals to whom it has been presented, as an important contribution of its kind to the illustration of the Zendic literature, to which so much attention has of late years been directed in Europe by Burnouf, Bopp, Lassen, Westergaard, Spiegel, Roth, Brockhaus, and others. In 1842 Bombay had the privilege of enjoying a visit, undertaken purely in connection with the Zoroastrians of Western India, of Professor Westergaard of Copenhagen, one of the most distinguished scholars which Europe possesses. We had the privilege, during the months that he was at the presidency, of holding much intercourse with him, and of enrolling him in the list of our honorary members. From India he proceeded in 1843 to Persia, where he visited the remnant of the Gabars at Yazd and Kirman, and made additions to the great stock of Zoroastrian manuscripts procured in the East by his honoured predecessor, Erasmus Rask. On his return to Europe, he commenced the preparation of a complete critical edition of the whole of the Zend texts with notes in English; of a Grammar and Dictionary of the two dialects embraced by the Zend writings; and of a translation and exposition, also in our

* To Professor Eastwick our Society is also indebted for the translation of the Kissah-i-Sanján, or History of the Arrival and Settlement of the Pársís in India, published in the Fourth Number of our Journal.

language, of the whole of the Zend-Avastá, as thus edited and illustrated by himself. While preparing the Avastá in its original, he has carefully examined and compared the manuscripts taken from the East by Rask and himself, now in the university library at Copenhagen; those which formed the earlier acquisitions of Anquetil du Perron, including the additions to them by M. Burnouf, now at Paris; those in the libraries of the East India Company, British Museum, and the University of Oxford, in England; those which I have myself acquired during the last quarter of a century in India; and a few transcripts and collations with which I have been readily favoured for his use by the successors of Mullá Firúz and Mr. Dhanjibhái Frámjí. The results, as far as the learned professor has advanced in his great undertaking, are most satisfactory and encouraging. His edition of the Zend-Avastá, as far as it is now recoverable, and the first which has appeared in print in a complete form, is now on our table; and every person who examines it must admit the extreme care and attention with which it has been executed. The last fasciculus of it contains the Preface and Introduction to the whole. At the general results which it indicates we may glance for a few minutes. The oldest Zend manuscripts in existence are now in Europe. They were written in 1323 from copies from Persia, and have consequently not an Indian source. The later manuscripts have been prepared both in India and Persia. They all contain the same text, disfigured often, however, by cacographies, interpolations, repetitions, and omissions, to the removal of which a rational criticism has to be applied. Though they occur mainly in a fragmentary form, they are the remnants of a collection made many years posterior to the composition of its pieces. They are not the production of a single man, be it Zoroaster himself or one of his disciples; nor "have they ever formed an exact, scientific, and self-consistent system of religious belief and lore." The several portions of the Avastá, like the hymns of the Vedas and the songs of the Edda, have sprung from different bards and teachers, who have represented their particular subject each according to his own view. Tradition assigns Zoroaster, to whom they are ascribed by the Pársís, to Bactria. The opening of the Vandidad, their historical and doctrinal portion, shows a very limited acquaintance with any countries not adjoining to Bactria; the Yaçna, their largest hymn collection, leads us to infer that the distinct tribes of Ragha, mentioned in the Avastá, did not recognise any spiritual master common to the whole nation; and none of the ancient texts take any notice of the names either of Media or Persia. We are led to associate these texts, in consequence, with a time anterior to Cyrus who conquered Bactria,

and perhaps to Dejoces who collected the tribes of Media into one nation under his own sway. Their language in its two proximate dialects of the mountains and plains of North Irán, for such there are, has a greater store of grammatical forms, and has an appearance less worn and smoothed down, and is consequently more ancient, than the old Persian tongue of the inscriptions of Darius, the nearest cognate branch. Some of the texts may have originated in a later age; but these must be comparatively few in number, and are probably anterior to their delivery to the nations of Western Irán for further cultivation. When this extension of the lore of Zoroaster to the west occurred is not known. Herodotus does not mention the name of Ormazd, the greatest god of the Avastá; but Darius, the son of Hystaspes, we find, from his tablets, invokes him as the creator of heaven and earth. The faith ascribed by Herodotus to the Persians is not distinctively the lore of Zoroaster; nor were the Magi in the time of Darius the priests of Ormazd, nor favourites of that the greatest of the Persian kings, by whom, indeed, they were cruelly treated.* The legendary traditions of the Párs'ís refer not, as has been long thought, to the Achæmenian princes, but to the personages of a North-Iranian mythology, terminating with Vishtáspa and his son, with whom the Achæmenian Artaxerxes the Long-handed has been associated, as if he had specially contributed to the propagation of the Zoroastrian belief in Western Irán. The Magi, eventually turning to the faith of their sovereign, became the priests of Ormazd. The Zoroastrian doctrine of god in his qualities, however, never became the universal and popular belief. The inferior physical divinities, partly congenial with the ancient gods, assumed higher stations, and Artaxerxes the second and third erected temples to Mithra and Anáhita, or Venus. Of this later development we may have a few memorials in Zend, composed, notwithstanding, in the same idiom as those from Bactria. With this general view of matters I entirely agree; and that for the reasons alluded to by Mr. Westergaard. The state of society and priestly authority referred to in the Vandidád is certainly not that of the Achæmenian sovereigns of Persia, who, if they were the men which their own tablets and the Greek histories represent them to be, never could have tolerated the administration of the peculiar law which that work contains. It could not have originated in the Parthian times, which were so much under the influence of the civilization introduced by Alexander and the Greeks. Párs'í tradition refers

* Compare with this the opinions of Colonel Rawlinson in Jl. of R. A. S. vol. xv. pp. 245-256.

the revival of its influence to the Sassanians of Iranian descent, who rose against the Parthians, A. D. 226; and it is almost certain that it was in the reign of these princes that the collection of the Zend fragments, such as we now have it, was formed from the memoriter repetition of the Mobeds, or possibly from writings possessed by them from an earlier age. From the fall of the Achæmenians to the rise of the Sassanians, five centuries had intervened; and in this interval, not to go further back, much might be forgotten and mistaken. This, says Mr. Westergaard, accounts for the fragmentary state of the Zend writings, and the "unintelligible passages, mutilated sentences, and uncouth words, where recollection must have failed, or where only defective pieces of written documents were preserved," without impeaching the honesty of the Mobeds of those times, who appear to have done their best, connecting the fragments together and disposing of them in liturgical form, with a few connective sentences and pieces, and that often without regard to their congruousness or self-consistency. With their attempts to preserve the texts, the Mobeds, probably in the later periods of the Sassanian rule, which terminated before the middle of the seventh century, combined that of preserving their interpretation in a language called Pehlevi. "But the name Pehlevi," says Mr. Westergaard, "has, in so far as it concerns us here, two distinct significations. The official language of the Sassanian kings was called Pehlevi, and this is not any Iranian tongue, but, as far as I have been able to decipher it, a Semitic one, in two closely related dialects, with some intermixture of Persian words. As this idiom was the only one which the Sassanians employed on their coins, and in inscriptions placed not only at the western borders of their empire but also in the very centre, at the ancient Persepolis, I scarcely doubt its being the only Pehlevi language of that age, the only one used in writing, and consequently opine everything composed in those days to have been indited in what I would call the Sassanian Pehlevi. But this Semitic language differs essentially from what Neriosangh [the Sanskrit translator of a part of the Avastá] calls Pehlevi (Pahlavi-bháshá), which has, indeed, the same written character, but is by nature Iranian and particularly Persian. This is the proper Zand or *commentary* language; it is employed in the composition of several works long after the fall of the Sassanians, and has remained in use to this day. The way of writing the Zand-Pehlevi is called intricate by Neriosangh; and so in fact it is, not only from the external shape of the several letters and combinations of letters, but especially from the great number of arbitrary signs or ideographs for pronouns, prepositions, and particles, which have the appearance

of real words; and from the adoption of Semitic words strangely marked by peculiar signs, which pertain to the writing and do not enter into the language. Therefore, whenever the Zand-Pehlevi is transcribed into other characters, the Zend, Persian, or Gujarátí, and thus the *Zand* is explained or made readable by a *Pázand*, all signs of every description are expressed by the words which they represent; the Pazand language being the same as the Zand-Pehlevi, differing only in the written letters about in the same way as the Hindustání and the Hindí. The identity of the Zand-Pehlevi and the Pázand language, hidden to the Pársí teacher of Anquetil, was known by Neriosangh, and the Persian lexicographers have justly referred the Zand-Pehlevi words to the idiom of the Zand and Pázand. The object in disguising the Persian dialect made use of in such a singular, artificial, and unnatural garb, by which the very language assumes a foreign and uncouth appearance, could not possibly have been to make the books thus written accessible to the layman, for the writing, being too difficult, requires no inconsiderable study. It seems to me to have been quite the contrary,—a wish to conceal them from the people, as well as to surround the learned and initiated with an additional show of erudition in the eyes of their own brethren, and perhaps also of the believers in the victorious Islám. As the Zand-Pehlevi, derobed of the artificial garb of its written characters, agrees with what we know about the Deri, as it has adopted words from the Sassanian Pehlevi, and in general displays a dialect somewhat different from that which has grown into the common Neo-Persian, I am most inclined to refer the fabrication or invention of the artificial Pehlevi writing and the composition of the Zand-Pehlevi translations and commentaries to a period shortly before or after the fall of the Sassanians. These translations may have been based upon older ones, indited in the Sassanian Pehlevi, whence also Semitic forms might have been taken, but they have not influenced the digest of the ancient texts; on the contrary, in trying to render the text word for word, they betray how scanty the knowledge of the sacred language must have been at that time. Still these Pehlevi translations have a very great value, both because they give us specimens of a Persian dialect older than the modern Persian language, and because they display the state of the ancient texts at a period anterior to that of the oldest MSS. Yet their importance is much lessened by their having reached us only in single manuscripts, and by the suspicion that the transcribers have not thought it necessary to reproduce the translation with the same fidelity as was required for the text." These are interesting statements as to matters of fact well worthy of

being noted. Mr. Westergaard thus, in substance, continues the history of the Zoroastrian writings. The defeats at Cadesia and Nehavand (A. D. 636 and 641) overthrew the Sassanians and struck a mortal blow at Zoroastrianism, which was soon restricted to Yazd and Kirman, nearly isolated by partial deserts. The Zoroastrian manuscripts originating from these contiguous districts form, with all their minor variations, but what may be called a single recension. The first arrival of the Pársís, a small colony from the Iranian stock of the Zoroastrians, in India, is involved in obscurity, though tradition associates it with the fall of the Sassanians and the island of Ormus as its starting point. Commerce, too, may have had its influence in its origination and promotion. Though excluded from the Hindu community by the system of caste, the Pársís early lost any books of the Zoroastrian faith which they might have brought with themselves to this country. In the fourteenth century, as they themselves allow, their copies of the Vandidád had altogether perished. The priest Mahyar brought from Yazd the copies of the Vandidád with the Pehleví translation, from which all the extant manuscripts of that work are descended. The original of all the Indian Vandidád Sadáh manuscripts, that is, the Vandidád arranged liturgically, must have also come from Yazd, perhaps not long before the beginning of the seventeenth century. In the beginning of the eighteenth century, Jámásp affirms that there was not in India any copy of the Farwardin Yast. All the Indian manuscripts, as we have already said, have had a Persian origin.*

So much for the results of Mr. Westergaard's labours, as intimated in the first volume of his work, which has lately appeared. Further notices we have of them in his valuable paper on the Ancient Iranian Mythology in the Eighteenth Number of our Journal. We shall shortly, we hope, have it in our power to compare them in detail with those of the learned and zealous Professor Spiegel of Erlangen, who is also editing an edition of the Zend writings, with a German translation, of which

* Our venerable and zealous member, Mr. Romer, still holds the opinion that the Zend is an artificial fabrication. See his pamphlet entitled, "Zend: is it an original Language?" published in London in 1855. Though his scruples,—founded principally on the obscurity of the history of the Zend, the difficulty of its infitting with the Persian, the comparative worthlessness of its literature, the tampering of the Pársís with the Pehleví, the fabrication of the language of the Dasátír, etc.,—have in some quarters not been treated with sufficient respect, they will probably vanish under the present extended study of the Zend, the genuineness of which, as a whole, is most apparent to those who most attentively mark its peculiar and numerous relations to the other Indo-Teutonic tongues.

several parts have already appeared, and who has also published grammars of the Pársí and Pehleví languages, which are anxiously looked for in India, more particularly after the notices which he has given of them through our learned associate Mr. Murray Mitchell, to whom, I would observe in passing, our Journal is indebted for valuable and judicious abstracts of several of the very interesting papers in Zend literature published in the fresh and able Journal of the German Oriental Society, certainly one of the most vigorous of all our oriental periodicals. With a Westergaard and Spiegel engaged in Europe in the deepest researches connected with the Zendic and Pehleví literature we may well in this place make a general pause in our labours as far as its essentials are concerned. We may, however, I conceive, continue, with much advantage, to act as their humble auxiliaries. Should any Zend fragments have been overlooked by Westergaard, let them be speedily brought to his notice, both on his own account and that of Dr. Spiegel.* The Pársí method of treating the Pehleví languages will be interesting to the philologers of Europe, when fully explained to them; and much light, I conceive, can be cast on it by the collection and republication of the quotations which have been made from it, with their accompanying readings and interpretations, often of an opposite character, by Edal Dáru and Mulláh Firuz in the Kábízah controversy. Mr. Dhanjibhái Frámjí's Pehleví Grammar in Gujarátí, though very brief, is an acceptable offering to oriental literature; and much more so will be the Zend Dictionary which he is about to publish, though, as he is aware, it will be merely a help to our friends in Europe, who are entering so deeply into all questions connected with the Zoroastrian lore. Every Pehleví work possessed by the Pársís, whether a translation of the Zend, or an original composition, should be given to the public. I am happy to be assured by the distinguished family of Sir Jamsetjee Jejeebhoy that copies of the Wajarkard in this tongue, printed for the Jamsetjee Translation Fund, will now be presented to all competent parties by the managers of that Fund.†

From the Zoroastrians I pass on to the Jainas, the principal habitat of whom is now in Western India, where three of their five sacred mountains, A'bu, Pálitháná, and Girnár, are situated. They are among

* In consequence of the remark here made, two Zend pieces, not yet printed, have just been put into the hands of Dr. Wilson by Dastur Peshutan and Mr. Pestonjí Mánekjí (at the request of Sir Jamsetjee Jejeebhoy) and forwarded to Professor Westergaard.

† An adverse critique on the Wajarkard, principally from a religious point of view, has just appeared in Gujarátí at the Oriental Press.

the most enterprising of our native merchants; and their influence, for good or for evil, is daily extending in the provinces of Gujarát and Rajputáná, in which they have systems of proselytism, unknown almost to other classes of the natives, very actively at work. They are a sect of Buddhists; but the history of their secession from the parent stock is yet unknown. The most valuable of the local chronicles, intermixed with incredible legends, are in their possession. Their own literature, though full of extravagances, is of a curious character, and is far too little studied. A valuable contribution to its elucidation is the volume by our learned associate, Dr. Stevenson, which contains the translations from the Maghadí, through the help of the Gujarátí, of their Kalpa Sútra, to which they attribute great importance, and of the Nawa Tatwa, expository of their metaphysical tenets. To Dr. Stevenson we are also indebted for some remarks on the relation which exists between the Jaina and Brahmanical systems of geography. Colonel LeGrand Jacob has given us transcripts, with translations, of the principal inscriptions on their temples at Pálitháná; * while Professor Wilson has given us the material and meaning of those, of a more important character, found at A'bu.† Dr. Glasgow, of Rájkot, has published a translation of one of the hymns used in their practical worship, which forms a very curious document. It was generally understood that our library contains some valuable portions of their literature in manuscript; but a late examination of the volumes in our possession which were thought to embody it has convinced me that their worth has been over-estimated. The following are the pieces of which they are composed. The Upásam Sútra, in Maghadí and Gujarátí, treating of Morals and Manners. The Ráyapasen Sútra, in Maghadí, on the Jaina Doctrine and Practice of the Preservation of Animal Life. The Jivabhigam Sútra, on Things Physical and Moral. The Uttaradhyana Sútra, read for the Jainas when they are dying. The Prithivi Ráj Vćla, a genealogical work. The Surya Pragnaptí (or Pannatí) Sútra, the Natural History of the Sun. The Hira Vijaya Suri Prásadikrit Prasho Har Samudayet Shishya Pandit Kirti Vijaya, explanatory of the principles of the Jaina religion. The Dasaví Kálik Sútra, on Chastity. The Harsh Kola Dipika Sútra. The Thánang Sútra, on Physiology. A Jaina Catechism. The Anuttara Vaváyi Sútra, a History of the Inferior Deities of the Heavens. The Hémachandra Samvigdh Nám Kosha, the well-known

* Lord Elphinstone, on his late visit to this locality, had these inscriptions recopied. The newly furnished text remarkably agrees with the old.

† See Translations of the Asiatic Society of Bengal.

Dictionary of Hémachandra. Most of these works are, in all probability, more curious than useful. I am acquainted with a native competent to translate any of them from the Maghadí into Maráthí, from which portions of them, after comparison of them with the original, might be transferred into English, for publication in our Journal. More valuable acquisitions than they are would be the Charitras of some of the different Rajput princes, such as the Kumár Pál Charitra, and the Mahátmyas of the sacred mountains, such as the Shatranji Mahátmya of Pálitháná, which are in the hands of the Jainas.

Of the Buddhists, whose religious development is of exceeding interest in the history of India and the adjoining countries, and whose works furnish the only key which has yet been found to ancient Indian chronology, we have no living representatives in our neighbourhood. Their most important ancient remains, however, are at our very doors, many of them, which had escaped notice for ages, having been lately brought to light. The following is a list of the papers treating of them which appear in our late proceedings, according to the dates which they bear. On the Ashoka Inscriptions at Girnár, by Captain G. L. Jacob and N. L. Westergaard, Esq. Brief account of the Minor Bauddha Caves of Bedsa and Baja near Kárlá, by N. L. Westergaard. Mr. Prinsep's Correspondence with Dr. Burn on Indian Antiquities. Historical Researches on the Origin and Principles of the Bauddha and Jaina Religions, by James Bird, Esq. Correction of Errors in the Lithograph of the Girnár Inscriptions by Capt. LeGrand Jacob. Memoir on the Cave-Temples and Monasteries and other Ancient Buddhist, Brahmanical, and Jaina remains of Western India, by John Wilson, D.D. Memorandum on some Buddhist Excavations near Karád, by H. B. E. Frere, Esq. Note on the Rock Inscriptions in the Island of Salsette, by J. Stevenson, D.D. Second Memoir on the Cave-Temples and Monasteries, and other Ancient Remains of Western India, by John Wilson, D.D. Historical Names and Facts contained in the Kánhérí Inscriptions, by J. Stevenson, D.D. On the Násik Cave-Inscriptions, by J. Stevenson, D.D. Buddhist Cave-Temples in the Sirkárs of Baitalwádí and Daulatábád, by W. H. Bradley, Esq. Sahyádrí Inscriptions, by J. Stevenson, D.D. Description of the Caves of Kalví in Malwá, by E. Impey, Esq. Descriptive Notices of Antiquities in Sindh, by H. B. E. Frere, Esq. All these papers are in addition to the well-known papers of Mr. Erskine, Colonel Sykes, and Captain Dangerfield, and contain important information, with statements of opinion and speculation worthy of respectful attention. Other valuable papers on the matters to which I now refer, especially by Dr. Stevenson and the Messrs.

West, have been laid before the Society. Government has shown great liberality in procuring, through Mr. Fallon, many pictorial illustrations of the Buddhist and also of the Brahmanical Cave-Temples and other excavations, though much remains to be done—by photography, as has been lately resolved on—for the full representation of these historical wonders. We are also indebted to it for the employment of an officer in connection with our Cave-Commission for copying the Buddhist inscriptions at some of the principal excavations. Notwithstanding the diligence of Lieut. Brett in the work last alluded to, it has not—perhaps owing to the fault of the lithographer, for whom Mr. Brett is not responsible—been altogether successful. Major Cunningham, the distinguished Buddhist antiquarian, and I, on a visit the other day to Kánhéri in Salsette, on comparing the copies of the inscriptions in our Journal with the originals at that place, reluctantly came to the conclusion that the discrepancies, principally in letters which the wear and injury of the rock has rendered difficult of decipherment, are so numerous that confidence in the translations which have been so commendably attempted of them by Dr. Stevenson and others must be greatly impaired, and that it is inexpedient to invite the particular attention of orientalists to them till they have all been minutely collated with the originals. Were Mr. Brett at hand to make the collation, he might be again employed for the purpose; but in his absence no better way of dealing with them occurs to me than that of our employing a learned native who knows the Cave character and language,—and such a qualification is required for successfully dealing with them,—for their exact revision in connection with a new attempt to translate them. A correct edition of the Girnár tablets, we may presume, may now be obtainable from a collation of the various copies which have been made of them. Mr. Prinsep's attempts to translate these tables have been greatly improved by Professors Wilson and Burnouf. I rejoice to be able to intimate that what remains to be done respecting them will probably be attempted by a most competent party, Mr. Edward Thomas, of the Bengal Civil Service, who is now in correspondence with myself respecting them. Our Cave and Antiquarian Commission still exists; and its inquiries continue to be prosecuted without intermission. We regard with special interest the Lilata Vistara, the legendary life of Buddha, now publishing in the Bibliotheca Indica at Calcutta. Sir Erskine Perry has furnished our Journal with an abstract of his life, after Lassen, whose great work on Indian Antiquities is invaluable.*

* Translations of portions of Lassen's Indische Alterthumskunde have appeared

More interesting, in certain respects, than departed sectaries, are the existing masses of the living population of India. The Indian ethnographical papers of our members are of particular value. Among these are to be noted those of General Briggs, on the Banjharás, in our Transactions; of Sir John Malcolm, on the Bhílls, in the Transactions of the Royal Asiatic Society; of General Walker and Captain MacMurdo, on various tribes in Kachh and Káthiáwád, lithographed by Government, or published in our Transactions; of Mr. R. C. Money, on the Kapriás, in the Transactions of the Royal Asiatic Society; of Dr. Wilson, on the Wárálís and Kátodís and other Mountain and Forest Tribes, in the Journal of the Royal Asiatic Society, and in his work on the Evangelization of India; and on the Jádejás and other Rajputs addicted to Infanticide, in his History of the Suppression of that horrid custom, just published; of Captain Postans, on the Kánphatís of Dámodar, in the Journal of the Bengal Asiatic Society; and of Colonel LeGrand Jacob, on the Tribes in Káthiáwád in general, in the Journal of the Bombay Geographical Society. Some most valuable documents of this description, which have been for a considerable time in the Government archives, are now being published in the Selections from the Government Records which are appearing under the auspices of our present distinguished patron. It is a matter of comparatively little consequence how they be laid before the public; but their value would probably in some instances be enhanced if they appeared first in the general proceedings of a Society looked to for information on all the diversified tribes and tongues of this great country. I repeat the opinion, that the acquisition of knowledge respecting them is of very great consequence. "Whatever tends," says Robert Hall, "to render our acquaintance with any portion of our species more accurate and profound, is an accession to the most valuable part of our knowledge." Before we can govern our subjects in India aright we must know them. The inexpediency of the neglect of even the most insignificant tribes, in our general schemes of enlightenment and industrial improvement, is sufficiently illustrated by the present relations to our rule of the savage Santhals in Bengal. Some curious facts relative to some of the aboriginal tribes around us have lately been noticed. The Parwáris of the Maráthí country, now so degraded, are the Porvari of Ptolemy of the second century, in his days evidently a considerable people. The

in late volumes of the Oriental Christian Spectator published in Bombay. It is greatly to be regretted that the whole of the work is not rendered into English under the auspices of its eminent author.

Bhílls are the Phyllitæ, and Gonds the Condali of the same author. The latter people I take to be the representatives of the Chandáls, or erroneously esteemed "outcasts" of the ancient Hindus. The Shúdras were originally a people on the banks of the Indus. The Kunbí cultivators of the Dakhan should not be reckoned so much Shúdras as Vaishyas; and from their appearance and language they are probably mainly a branch of the high A'ryá family. In fact, they are called A'ryars to this day by their neighbours the Canarese. The Ahírs of Kachh and Káthiáwád are the descendants of the Abhírs of the Puránas. Their original country in Sindh is called Abiria by Ptolemy. The Mángs belong to the Southern family of Indians. They still retain many Canarese words in their vocabulary.

In regard to Hindu literature, our Society had, and still has, its own special duties to perform. In this department, the services of Major Edward Moor and General Vans Kennedy among our deceased members are universally admitted, while those of Dr. John Taylor are not to be overlooked. My own expositions or exposures of Hinduism, which come next in chronological sequence, though they have had their own influence on native enlightenment, having been composed by me at an early stage of my oriental studies, are not what I would wish them to be, and am endeavouring by degrees to make them. Dr. Stevenson did not put his name to the specimen of the Rig-Véda, with English and Maráthí translations, which was lithographed at Puná in 1832; but it is worthy of notice as, after the extracts of Colebrooke, the first consecutive portion of the till lately mysterious Védas given to the European public. In conjunction with Major Shortrede, he procured for Professor Burnouf of Paris some of his Védic manuscripts, at a time when the scruples of the Bráhmans led them to withhold them from the gaze of the impure Mléchchhas. His own edition of the Sáma Véda, though superseded by the more critical one of Benfey, with its various readings and valuable indices and glossary and translation, was at the time of its issue, as well as its translation, a desideratum. It is perhaps well that in the matter of Védic editorship no duties are now required of any of our number. With imperial liberality the East India Company is presenting to the literary world the whole of the Rig-Véda with the commentary of Sáyana Achárya, under the able editorship of Dr. Max Müller. This work, as it proceeds, is being translated by the most trustworthy hand which Europe affords, that of Professor H. H. Wilson, two volumes of whose version have already appeared. Dr. Albrecht Weber of Berlin, in every respect a most competent party, and the editor of the interesting Indische Studien

now appearing in that city, is giving us the whole Yajur-Véda; while Dr. Roth, well known for his Védic and Zendic research, and Mr. Whitney, a young American gentleman, are unitedly publishing the Sanhitá of the Atharva Véda, not the least curious of the Védic collection. All these works are in addition to the translation in French of M. Langlois of the whole of the Rig-Véda, the first complete version of that work which has been executed, and which will not be overlooked in the history of oriental literature. The Bráhmanas of the Védas are awakening attention, and various extracts from them have already been printed by the orientalists of Berlin. The grammatical and glossarial works illustrative of the Véda will not be delayed. Dr. Roth has been busy for some time with the Nirukta. (It has perhaps been already published.) The most important works connected with the more advanced literature of the Hindus are almost all published, or preparing for the press. The Bibliotheca Indica is furnishing us with the Upanishads, edited and partly translated by Dr. Röer; with the most important treatises illustrative of the Schools of Indian Philosophy, by Dr. Ballantyne and others; with the treatises which contain the Hindu Astronomy, by Mr. Hall; with the collection of the Puránas, begun to be edited by the Rev. Krishna Mohan Bánarjí; and with other interesting works. What we require most for the West of India is the completion of the translation of the Bhágavata Purána, of which three volumes were published by Burnouf before his death; the publication of the text, with a translation, of the Sahyádrí Khand of the Skand Purána, which contains our local legends, some of which so excited the wrath of the late Péshwah that he ordered every copy of the work which his emissaries could procure to be destroyed; the translation of the Mahátmyas of the different months of the year, which throw more light on the present religious observances of the people than all other works put together; the translation of the Mahátmyas of our principal shrines, and places of pilgrimage, as those of Dwáraká, Elurá, Násik, Jejurí, etc., which, though filled with absurdities, explain the popularity of these shrines, and many of the rites which are observed in connection with them, which are attracting increased notice, as exemplified in that of Jejurí lately visited by Mr. Murray Mitchell, as formerly by Dr. Stevenson and myself. Our vernacular literature does not afford very much of interest to the orientalist; for the Maráthí poetry consists principally of paraphrases of the mythological legends of the Sanskrit works set forth in wretched versification, though it affords a few interesting gleanings, principally in the works of Tukobá, noticed by Dr. Stevenson and Mr. Mitchell. The proverbs of the Maráthí nation are

numerous and valuable. About five hundred of these were lately published in Puná; but Mr. Murphy and myself have, independently of one another, formed collections containing respectively upwards of 1,800 of these proverbs, and giving altogether 2,200 when they are collected together. When the agreement in the amount of each of our collections was first noticed by Mr. Murphy, it occurred to him that some of the native assistants employed by us might have dishonestly possessed themselves of some of the distinctive fruits of our individual labour, disposing of them to the other party; but the comparison of our manuscripts showed him that this was not the case. In a note to me, he says, "Your remark about the minute discrepancies in the text of the proverbs common to both our collections is very just. I see it very clearly; and I agree with you that it is conclusive as to the independence of the sources whence they were derived. I think the proposal to combine the two collections, after a comparison of the texts, a very good one." This labour, I shall be happy if Mr. Murphy will undertake, either in connection with this Society or the Dakhan Vernacular Society. The Proverbs of Gujarát will probably not be less interesting than those of the Mahárásh'tra, though many of them may be found to have a common origin. The songs of Gujarát, of which a collection has been made by the Rev. Dr. James Glasgow, are very curious. The Rev. P. Anderson, one of our learned vice-presidents, has in an excellent paper given us an interesting account of the curious Bhatti Kávya, illustrative of the grammatical rules of the Sanskrit grammars of Panini and the Kaumudí. Dr. Stevenson has favoured us with several papers on the connection of the Northern and Southern Families of Indian Languages, a most important subject of research; while Sir Erskine Perry has, in our Journal, attempted, not without commendable success, to sketch the boundaries of the various Indian Dialects. A Parallel and Comparative Grammar of the Maráthí and Gujarátí Languages, distinguishing their Sanskrit and Scythian elements, and illustrating them by references to the cognate tongues, appears to me —notwithstanding the meritorious grammatical works of Dr. Stevenson and Messrs. Clarkson and Burgess—to be a great desideratum in our local philology. The lexicographical labours in the Maráthí of Mr. Molesworth, formerly aided by the Messrs. Candy, are unsurpassed by any connected with oriental literature. A new and greatly improved edition of the Maráthí Dictionary is at present in the press. Most important services to our Indian and Persian literature are being rendered by our learned member Professor Eastwick, and his associates, who, in connection with the press of Mr. Austin at Hereford,

are reflecting much honour on our country in the eyes of foreign orientalists.

I pass on to the Musalman literature. The most intelligent and judicious digest of the Muhammadan History of India which has yet been given to the public is that of our former distinguished patron and president the Hon. Mr. Elphinstone. Mr. Erskine's History of India under the two first Sovereigns of the House of Taimur, Báber and Hamáyun, is an entirely exhaustive work, founded on oriental authorities, most difficult of acquisition and interpretation, and which leaves nothing further to be desired respecting the affairs of which it treats. The principal Muhammadan Histories of India noticed by Sir Henry Elliott are about to be published by the Government of the NW. Provinces, with the exception of those which have already been printed in Bombay. Dr. Sprenger, the best Arabic scholar in this country, is preparing a great work (a part of which, to be afterwards enlarged, was printed at Allahabad in 1851), the Life of Muhammad from original sources, to which a large accession has been procured by him during his late visit to Syria and Mesopotamia.* He is also, with his zealous coadjutor Lieutenant Lees, and others, laying most valuable works connected with Saracenic history and science before the public through the Bibliotheca Indica. Several learned and original papers connected with the biography of Muhammad have lately been published in the Calcutta Review. By the lapse of the Sátárá state, the Bijápur collection of Arabic and Persian works has become the property of the Bombay Government, which has been taking counsel as to the best method of its disposal. On the city of Bijápur and its Inscriptions, our Journal contains a valuable paper by Dr. Bird, who has also furnished the Society with a History of the Kalhora family of Sindh by the late Captain MacMurdo, and other interesting papers. Capt. Burton has added much to our knowledge of the languages and people of the Valley of the Indus, which has been still further illustrated by valuable papers published by the Bombay Geographical Society.

To the department of Antiquities to which the attention of our Society is frequently directed, I have already in some respects referred in connection with Buddhism. A few additional notices, however, are still required for the completion of this brief sketch. Highly interesting Scythian remains have been brought to notice as existing in the Dakhan by the able papers of Captain Meadows Taylor. Our Journal

* To his store of Arabic manuscripts, the best in any private collection, Dr. Sprenger has, since the reading of this address, procured some most valuable additions in Bombay.

has a few numismatological notices, illustrative of individual coins and collections of coins which have been laid before us. The capital of the Sinhas in Gujarát, so long amissing, has been identified by myself with Sihor in the Goelwád province of Káthiáwád. (See Second Memoir on the Cave-Temples.) Walabbhí, Pattan, and other ancient sites have been examined without any considerable results. The Rev. Mr. Anderson has reviewed the genealogy of the Walabhí princes.

Natural History and Natural Science have often been cultivated in India in union with oriental literature. Jones, Colebrooke, and Carey were nearly equally distinguished in both departments. A division of labour in respect to them, however, is at once to be expected as a general occurrence. In the field of Natural History, Mr. Carter, our able and zealous secretary, and Dr. Buist, have been our most indefatigable and successful collaborateurs. Dr. Carter's geological, zoological, and botanical papers deservedly occupy the largest space in our Journal; while the most important of those of Dr. Buist appear in that of our Geographical Society, of which he is the energetic executive. The Rev. Messrs. Hislop and Hunter of Nágpur have contributed much to the illustration of the Geology of Central India. In Dr. Gibson, Mr. Law, Mr. Nimmo, Mr. Dalzell, and other friends, we have some of the best of Indian botanists.* Colonel Sykes honours Britain, as well as Bombay, in the principal physical societies of Europe.

With the mention of Dr. Carter we cross the Indian Ocean. His contributions to the Geology, Geography, and Ethnography of the Coast of Arabia are the most instructive scientific documents which we yet have, connected with that interesting portion of the world. In our Journal, we have several valuable papers on Aden, Abyssinia, Egypt, and the Red Sea by Dr. Bird, Mr. Orlebar, and others. Without presuming to take the members of the Society at present in my own company to the "Lands of the Bible" or the ruins of Al-Hadhra, which I have identified with the Hazor of Jeremiah, I may make them pause with silent admiration for a short time at the tablets of Behistun, and the wonderful remains and records of Nineveh and Babylon with Colonel Rawlinson, who so lately delighted us and instructed us in this place, and who is now, with so much promise, prosecuting his literary researches in Europe. On the Topography of Nineveh, an invaluable paper, accompanied by maps, has just appeared in the Journal of the Royal Asiatic Society, the fruit of the observation and research of Commander Jones, of our Indian Navy. Captain Burton, though in a disguise

* A new and enlarged edition of Graham's Catalogue of Plants in the Bombay Presidency and its vicinity is a great desideratum.

which is not to be commended, has, after Burckhardt, thrown a flood of light on the Holy Land of the Muhammadans, and on the views, feelings, observances, and hardships with which they perform its barren pilgrimage.

Before concluding, on this occasion, I would respectfully make a few distinctive proposals for the consideration of the Society, with a view to the increase of its efficiency and the extension of its research. I am particularly encouraged to do this by the attendance on the present occasion of our Right Honorable Patron, whose zeal for the well-being and well-doing of the Society is quite in accordance with the distinguished and exemplary interest which he takes in every object connected with the improvement and advancement of Western India.

The following, I think, are among our most important desiderata :—

1. The regular publication of the Journal, at intervals not exceeding six months in ordinary circumstances, it being understood that the Secretary, with a view to the abridgement of his labours in editing it, shall enjoy the assistance, when practicable, of the members furnishing articles to its pages.

2. The presentation to the Society by Government of all official articles of a literary and scientific character bearing upon the objects which it is intended to advance, for illustration and comment and precise scientific editorship in the Journal. For example, the copies of old inscriptions which appear in the valuable volume on Kolápur published by Government might have been handed over to the Society, and given forth in a suitable form, with an identification of the dynasties, etc. to which they belong. The ethnographical papers, too, might well go through the ordeal of the Society. This disposal of them, in the first instance, would not be inconsistent with their subsequent introduction into the Government Selections which are carefully edited by Mr. Thomas and others for official and general use.

3. The Society should systematically seek to enlarge its library of printed books and manuscripts in the oriental and scientific departments, so as to afford every facility to its members to engage in those peculiar studies which it professes to countenance and advance. In the case of needful oriental manuscripts our library is particularly defective. Though not one of the richest members of the Society, the exigencies of my own engagements have forced me to purchase, from first to last during the last few years, a vast many more than the Society has done in its collective capacity. For an indiscriminate purchase of manuscripts, however, I would not plead. I ask only the acquisition of those which are needful for our actual research.

4. The Cave Commission should be empowered by Government to employ a learned Native, acquainted with the Cave character, to collate the transcripts of the Inscriptions made by Mr. Brett, and published in the Journal, with the originals, with the view of correcting errors, which, for reasons already mentioned, are abundant, notwithstanding the care of Mr. Brett.

5. This learned Native should afterwards be retained in the service of the Society, like the Pandit of the Asiatic Society in Bengal, for aiding it in decipherment, translation, and other similar occupations. Colonel LeGrand Jacob, who feels a particular interest in the objects of this meeting, attaches much importance to such an arrangement as this. Why should we not immediately take steps to the publication, in connection with Government, of a *Corpus Inscriptionum*, embracing the whole of the ancient *documenta* on stone and copper to which we have access?

6. It is desirable that one of the clerks employed by the Society should have a knowledge of Natural History, to give effectual assistance to the Secretary in the care of the Museum.

7. A monthly grant of money in aid of the objects of the Society should be solicited through Government from the Court of Directors of the East India Company. Large sums are given to the Bengal Society, while nothing is given to that of Bombay but presents of books and the rooms in which we hold our meetings and accommodate our library and museum. It is to be observed that our voluntary pecuniary contributions to science and oriental literature do not fall short of those made on the banks of the Ganges. They amount in round numbers to about a thousand pounds per annum.*

8. The Library of the Society should continue to be available on easy terms to all parties seeking to advance the objects of the Society, whether they be members of the Society or not.

These simple suggestions I wish to be leisurely considered by the Committee in all their relations before they are discussed by the Society. At the same time, I submit them in the strong desire and hope that they may be adopted. The Society, I believe, is conscious that a great work, which it is well fitted to overtake, is still before it; and it is reasonably expected that it will not fail to discharge the duties to which it is called. The power of enlightening, governing, and improving India, in both its secular and sacred relations, is greatly dependent on our knowledge of its past history and present state: and we cannot

* The total sum raised by the Society during the last five years amounts to Rs. 47,056-11-5.

too thankfully acknowledge the services of those who contribute to make us acquainted with its external character, so grand and diversified; with the peculiar springs and motives by which its varied tribes and tongues are influenced; with the languages and dialects with which intercommunion with them is to be maintained; with their actual condition as the subjects of the British empire, so providentially and wondrously established in these eastern parts; and with their probable destiny in the renovation of the world through the Word and Spirit of the living God.

At the close of Dr. Wilson's address, the Right Honorable Lord ELPHINSTONE, who, as Patron of the Society, presided on the occasion, rose and said:—I have not only been much gratified by the admirable discourse of our able and learned Honorary President, but not a little surprised, though certainly most agreeably so, at the accounts given by him of the energy of the exertions, and celebrity and amount of the performances, of the Society. Though very familiar with the great fame it had acquired, and enterprises it had accomplished during the earlier portions of its career, I had somehow or other become impressed with the idea that it had of late years slackened in its labours, or that these had become less celebrated and less numerous than they had formerly been. The discourse we have all just listened to with such delight has dispelled this delusion. I cordially concur with its author in the importance of the Society's labours; and I think it may confidently rely on Government doing everything in its power to assist it. I quite agree in the importance of pecuniary grants; and think that the State which makes them, under such circumstances as the present, secures an ample return for its money. Nothing can be more true than what has been said in reference to the advantageous nature of our position for the prosecution of those investigations in which the Society is engaged; and when we look around to the facilities we now enjoy for oriental study, beyond anything enjoyed by the founders of this Society, we must feel it doubly our duty to endeavour to turn these to account. Sir James Mackintosh, Mr. Erskine, and General Kennedy, the great labourers in the field in the earlier years of the Society, had neither collections nor manuscripts, library nor museum, to fall back upon. They had to trust exclusively to their own resources, and to provide aids to study and means of enlightenment for themselves.

His Lordship then recommended that the proposals of the Honorary President should be referred to a Select Committee composed of the office-bearers and of any members whom they or the Meeting might

wish to add to its number, and who should make a Report upon them to a future General Meeting. If adopted, he said, he should have great pleasure in supporting that portion of them which related to the communication of all subjects of interest to the Society which are to be found in the Government records, and in recommending the grant of some pecuniary aid.* The Court of Directors, his Lordship added, has always shown a laudable anxiety to promote the objects for which the Society was instituted, and he did not doubt that it would take the claims of the Society into consideration with its usual liberality. Lord Elphinstone also alluded to the advantages which the Society derived from the labours of other Societies in Europe, and from the interest in oriental research which has led so many distinguished men to devote themselves to it. He mentioned the mechanical advantages, as well as the literary ones which this generation enjoys over that which preceded it—he instanced lithography and photography especially, as affording great assistance in delineating antiquities, copying inscriptions, etc. And lastly, he alluded, among those who had done honour to the Society and to the country, to Colonel Rawlinson, whose interesting account of his discoveries in Assyria the Society had listened to a few months ago in that room. His Lordship concluded by moving a cordial vote of thanks to Dr. Wilson; this was carried by acclamation.

The business of the Meeting having closed, Colonel MELVILL rose to propose the thanks of the Meeting to their Noble Patron, who had done them the honour of taking the Chair. The Members of the Society must not only have been highly gratified by what had fallen from him, but must have felt the fullest assurance that His Lordship would do his uttermost to promote the interests of the Society, and bring about the realization of the hopes of assistance from the Treasury which he had held out.

* Since the meeting at which these observations were made, Government has granted a monthly salary to a learned Pandit, who is to act under the Cave Commission in the primary collation and decipherment of the ancient inscriptions. The question of a general *Corpus Inscriptionum* for India has been referred to the Court of Directors.

ART. X.—*Development of the Root-cell and its Nucleus in* Chara verticillata (Roxb.). By H. J. CARTER, Esq., Assistant Surgeon, H. C. S., Bombay.

Read July 10th, 1856.

LAST year I found it necessary, on account of the investigations I was then making, to ascertain the physical features which the protoplasm of the first few cells of *Chara* presented on their development from the *nucule*; but, not requiring to go further, I merely commenced from the bursting of the vacuoles of the new protoplasm into each other, and followed this up to the full development of the rotatory motion.* Latterly I have found it necessary to extend these researches, that I might ascertain also the changes which the nucleus presents in the fresh-water Algæ under cell-division, and having again chosen the roots of *Chara verticillata* for this purpose, I have been led to observe other features in the protoplasm which I had not before noticed, but which, together with the changes exhibited by the nucleus, I will now also describe.

Previously, however, it is advisable that I should state shortly, what has been published respecting the development of the roots of *Chara*, as well as that which is known of the formation of the nucleus generally, in the Vegetable Kingdom.

As regards the former, it has already been stated by C. Müller, in his excellent description of the development of *Chara*,† that "as soon as the nucleary membrane [embryo-sac] began to burst through the sporular membrane [brown-coat], like a bladder, and to expand it in a sacciform manner [to form the first cell of the plant-stem], it began to be developed in a sacciform manner on the opposite side" [to form the roots]. Nothing afterwards is mentioned about the roots, saving that, "each utricle forms a rootlet, and others follow it from simple

* Ann. and Mag. Nat. Hist. vol. xvii. pp. 110 and 111, pl. viii. fig. 35.—1856.
† Idem, vol. xvii. p. 254.—1856.

vesicular expansion of the nuclear membrane, so that it acquires at this end a complete head of root-fibrils."*

For what is known respecting the formation of the nucleus in the Vegetable Kingdom, I can quote nothing better than the result of Nägeli's researches, which he has summed up in the following manner, viz. :—"The nucleus originates in two ways ; either free in the contents of the cell, or by division of a parent nucleus.† The first mode is witnessed in the embryo-sac of the Phanerogamia (*Scilla cernua*, &c.), wherein "globular drops of perfectly homogeneous mucillage with a defined outline" appear; after which the larger ones present an "enclosed ring" ; and of these, he adds, "there can be no doubt, for the further development also confirms it, that the mucillage-globule is a cell-nucleus, the enclosed ring a nucleolus." He is also of "opinion that the nucleolus originates first and the nucleus subsequently around it"‡ ; lastly, he observes, "certain phenomena connect themselves readily with the hypothesis that they [the nucleoli] are utricles."§

As regards the second mode of origin, viz. that by division ; this is witnessed in the nuclei which are formed on each side the "secondary nucleus" in the parent-cell of the spore of *Anthoceros*."‖

Having thus briefly stated, as far as I am aware, the limits of our knowledge respecting the development of the roots of *Chara*, and the formation of the nucleus of the plant-cell, I will proceed to the subject of this paper, premising a short description of the first root-cell and its contents in the species of *Chara* mentioned, that the reader may recognise without doubt the parts to which I shall have occasion to allude.

This cell is a long narrow cylindrical tube, with one end attached to the *nucule*, and the other free. Its chief elements are the cell-wall and "primordial utricle" of Mohl.

Of the cell-wall nothing more need be said here than that it is as transparent, colourless, and apparently structureless, as unstained glass ; but

* Ann. and Mag. Nat. Hist. vol. xvii. p. 259.—1856.

† Henfrey's Translations, Ray Soc. Pub. "Reports and Papers on Botany," 1849, p. 168.

‡ Idem, pp. 106 and 107.

§ Idem, p. 172.

‖ Idem, 1846, pp. 261 and 262.—*Himantidium pectinale* (Kg.) affords a good example of it among the Algæ ; and in the same way I have seen it in some of the cells projecting into the gum-cavities of the bark of *Hyperanthera moringa* (Roxb.), the *Horse-radish tree* of India ; that is, both halves of the nucleus remaining opposite each other, on either side the septum, after the latter has divided the old from the new cell.

the protoplasm is composed of many organs, which I will first enumerate and then describe in detail. Thus, it is itself surrounded by a cell which we shall call the "protoplasmic sac"; then the protoplasm is divided into a fixed and rotatory portion; these again respectively enclose the nucleus, "granules," and axial fluid; while those small portions of matter which I have before designated as "irregularly shaped bodies"* are common to both.

*Protoplasmic Sac.*—This sac I have only been able to demonstrate satisfactorily by the aid of iodine and acids applied to the fixed protoplasm when it is about to undergo division for the second root-cell, as will hereafter be explained. Its existence, however, might be inferred, from iodine and acids failing to produce any separation between the fixed and rotatory portions of the protoplasm, for these cannot be considered to be in direct union, and, therefore, unless supported in their relative position by a membranous sac common to both, would most probably present a line of separation under contraction. Again, the "primary" nucleus ultimately becomes stationary in the midst of the rotating protoplasm, and it also must be fixed to something which is not only stationary itself but is also carried inwards with this part of the rotating protoplasm, when the latter is condensed and made to leave the cell-wall by acids; for the nucleus, or what remains of it, is at such times seen to be enclosed in the general mass of contracted cell-contents. Lastly, when the first root-cell assumes part of the function of the cell of the plant-stem, which is frequently the case, the green, peripheral cells appear in an abortive form, disposed in broken, scattered lines along its inner surface, and they also are drawn inwards with the general mass of rotating protoplasm under contraction from acids, with the remains of the nucleus within them again. Now these cells can hardly be supposed to be supported in their position by mere attachment to the cell-wall in the root-cell, any more than they are in the cell of the plant-stem, where they form a distinct layer. Hence, if the protoplasmic sac had not been seen, its existence might thus have been fairly inferred.

*Protoplasm.*—The protoplasm is a molecular mucus, which, as before stated, is divided into two portions, viz. a fixed and a rotatory portion. The fixed portion occupies the extremity of the cell, and extends backwards for about a hundredth part of an inch, while the rotating portion occupies all the rest of the interior of the tube. The latter, which is more attenuated than the former, merely encloses

* Ann. and Mag. Nat. Hist. vol. xvii. p. 106.—1856.

the axial fluid, and presents a few of the "irregularly shaped bodies" scattered through its substance, with, perhaps, a globular cell or two in its cavity; but the fixed protoplasm not only also contains a few of these "bodies," but, in addition, the nucleus, and the group of corpuscules at the extremity of the cell, which I have called "granules."

*Nucleus.*—This organ is at first located in that end of the fixed protoplasm which joins the rotatory part, and then consists of three elements, viz. a transparent, globular cell, which Nägeli has called the "nuclear utricle"; a more or less transparent mucus, which partly occupies its interior; and the nucleolus or kernel, which is a spherical body composed of an opaque, yellowish, homogeneous substance, with a single hyaline vacuole in its centre. This is the primary form of the nucleus in *Chara*. Afterwards it enlarges, the transparent portion or cell becomes elliptical, the nucleolus becomes flattened, its single hyaline vocuole is replaced by several which vary in size as well as in number; and these again disappear and reappear, but whether from collapse of the vacuole or change in position of the substance of the nucleolus, I am ignorant. The nucleolus is also now continually but imperceptibly varying its shape, being at one time elongated, and at another sub-round. Finally, when the nucleus has ceased to subdivide for the purpose of furnishing the new cells with nuclei, it moves backwards a short distance, and then becomes permanently fixed to the protoplasmic sac, where it grows still larger, and, ultimately, its nucleolus divides up into a number of small nucleoli. When the second or following root-cell becomes terminal, that is, it ceases to throw out any more cells, the nucleus, after the breaking down of the fixed protoplasm, moves about for some time before it becomes fixed, and this is effected partly by the rotating protoplasm and partly by its own locomotive power, which at this time is particularly evident, from change of form while under observation. I have stated that the "nuclear utricle" and its contents are transparent, but this is only in comparison with the turbid fixed protoplasm in which it is imbedded; for when it gets into the clearer cavity of the rotating protoplasm, it not only presents a cloudiness interiorly, but, a certain time after it has become stationary, also becomes filled with vacuoles, like those which will be found to be developed in the fixed protoplasm preparatory to its assuming a more attenuated form, and mingling with the rotatory part. In short, this is the last vital phenomenon presented by this organ; after which it passes into an effete amorphous piece of tissue, like cellulose.

*Round or "irregularly shaped bodies."*—These are small opaque

yellowish masses of protoplasmic (?) matter, irregularly scattered throughout both the fixed and rotating protoplasm, and seem to be the same as those which I have described under this head in giving an account of the contents of the protoplasm of the internode of the plant-stem, but they never grow large enough to arrive at those fantastic shapes which are found in the latter.* Like these, also, they are frequently seen appended to, or in the wall of a globular mucus-cell, and this cell may be transparent or clouded by the presence of molecular mucus, while it also frequently manifests a power of movement. Many of these bodies have very much the appearance of the small nucleoli into which the primary nucleolus divides, but as they appear in the cell before the latter takes place, this cannot be their origin.

*Granules.*—Lastly we come to the granules, which are of much interest, on account of their being grouped together in one part of the cell only, their marked characters, and their incessant oscillatory motion. They are situated in the fixed protoplasm close to the free extremity of the cell-wall, and are recognised by their dark margins, greenish colour, constant motion, and tendency to keep together in a group. At first they are round or elliptical, and of the tint mentioned, but after a while they become sub-round or angular, and colourless,—apparently effete. When the fixed protoplasm begins to be broken up by the development of vacuoles, they are seen to be scattered among the latter; but after the rotatory movement is completely established, they cease to be recognised. Their office seems to be connected with the extension of the cell, as they are only found at its extremity and in constant motion, but whether this motion is produced by themselves or by the protoplasm in which they are imbedded, I am ignorant. They are also present in the young cell of the plant-stem, but disappear in the way which I have stated, and are then followed by the appearance of the rudiments of the green cells or chlorophyll-bearing cellulæ. Is their office of a like nature, or are they homologous with the latter?

*Vacuoles.*—These form no part of the permanent contents of the protoplasm, but are hyaline spaces, which are temporarily developed in the new or fixed protoplasm preparatory to its becoming attenuated and rotatory. As they increase in number and size so they burst into each other, until a large space is thus produced in the centre, round which the protoplasm gradually begins to rotate. As before

* Ann. and Mag. Nat. Hist. *loc. cit.* p. 106, &c. pl. viii, figs. 11-13.

stated, they appear in the nucleolus and in the mucous substance of the nuclear utricle when the nucleus becomes stationary; they also make their appearance in the rotating protoplasm, just preceding its death.

Having now described one of the first root-cells specially and typically, let us turn our attention to the whole bunch as they appear about twenty-four hours after the germination of the *nucule*. Here we shall find, as Müller has stated, that they are developed from the "nucleary membrane" (which, for convenience of description, we will now term "embryo-sac"), on one side the plant-stem,—at first as one hemispherical cell, which afterwards divides into four or more root-buds. The first cell of the plant-stem, on the other hand, projects from the extremity of the embryo-sac in the form of a parabola, whose summit becomes cut off, for the second cell or internode, by a transverse diaphragm; round the circumference of which, again, on the *lower* side, there is an annular projection, which lodges the protoplasm, that afterwards becomes cut off and divided up into cells for the first node or verticil; thus allowing direct endosmosis to take place, not only between the first and second cells of the plant-stem, but also between the first cell and the cells of the first node. Sometimes these cells pass into roots, as the cells of any future node may do if the occasion requires it. In the figure of the germinating nucule which I formerly gave, it would have been more complete had I drawn another diaphragm close to the summit of the nucule, and placed the roots in a bunch on one side of it, but the reader can do this for himself, and then he will have the first cell of the plant-stem and first bunch of roots now described.* When a second plant-stem is formed, which is not unfrequently the case, this is developed out of one of the root-buds; hence it is not uncommon to see one of the latter in an intermediate state.

Now if we take the simple root-cell about the eighteenth hour after germination, when it will be about half an inch long and $\frac{1}{600}$ of an inch broad, and place it in water between two slips of glass for microscopic observation, under a magnifying power of about 400 diameters, we shall find, if the circulation be active, and the cell-wall strong and healthy, that the extremity of the latter, together with the nucleus and fixed protoplasm, which, as before stated, is about a hundredth part of an inch long and $\frac{1}{600}$ of one broad, will, in the course of about twenty-four hours, present the following changes:—

1*st stage*.—The nucleus, now about $\frac{1}{300}$ of an inch in diameter, is

* Ann. and Mag. Nat. Hist. *loc. cit.* p. 106, &c. pl. viii. fig. 35.

situated in that part of the fixed protoplasm which is next the rotating one; it is also now globular, and its nucleolus, which is about the $\frac{1}{1800}$ of an inch in diameter, spherical and opaque, with the exception of the single hyaline vacuole in the centre. After this, the nucleolus becomes somewhat flattened, its outline becomes sub-circular, and it presents several hyaline vacuoles of different sizes. The "granules" are now also in active motion at the other end of the fixed protoplasm, close to the extremity of the cell-wall, but, beyond these and the "irregularly shaped bodies," the fixed protoplasm presents nothing to interrupt its uniformity throughout its whole extent.

*2nd stage.*—After a certain time, during which the nucleolus has been successively changing its shape from a sub-round to an elongated form, and *vice versâ*, it assumes a grumous appearance, becomes slightly enlarged, and, growing fainter in its outline, gradually but entirely disappears, leaving a white space corresponding to its capsule or cell-wall, with a faint remnant of some structure in the centre. Subsequently, this space becomes filled up with the fixed protoplasm, and after about an hour and a half—but this varies—the nucleus reappears a little behind its former situation, but now reduced in size, and with its nucleolus *double*, instead of single as before; each nucleolus being about one-fourth part as large as the old nucleolus, and hardly perceptible. Meanwhile a faint septum is seen obliquely extending across the fixed protoplasm, a little beyond it, and, if iodine be applied at this time, the division is seen to be confined to the protoplasm, as the latter, from contraction, withdraws itself from each side of the line where the septum appeared, and leaves a free space, which is bounded laterally by an uninterrupted continuation of the protoplasmic sac. Hence the demonstration of the existence of this sac to which I have alluded. At this moment a spot, slightly lighter than the rest of the protoplasm, makes its appearance a little beyond the septal line towards the free extremity of the cell, and this is soon followed by the faint appearance of something else in its centre, which, as both become more defined, proves the former to be a new nucleus, and the latter its nucleolus. We shall, therefore, henceforth designate the first by the name of "primary," and the second by that of "secondary" nucleus. As the secondary nucleus becomes more evident, its nucleolus also is found to be *double*, and composed of two spherical nucleoli about the same size as those of the primary nucleus, when the latter first returned into view. These nucleoli, like those of the primary nucleus, also become opaque and yellowish, and each presents a single hyaline vacuole or circular area in its centre—sometimes more than one.

The nucleoli of the primary nucleus, after they have become distinct, soon unite and form one spherical nucleolus, with a single hyaline vacuole in its centre, thus assuming the form, which it first presents when the root has just budded forth from the root-cell of the embryo-sac. After this the nucleoli of the secondary nucleus also unite in the same way, and present the same spherical form when conjoined.

The primary nucleolus now becomes more opaque, sub-round or elongated, and presents a number of vacuoles of different sizes; while the septum has become fully formed and has taken on a sigmoid shape. Thus the second root-cell is completely cut off from the first.

*3rd stage.*—In this, the cell for the first bunch of rootlets is formed and provided with a nucleus; it commences in a convex, lateral projection of the first root-cell opposite the oblique sigmoid septum. The primary nucleus now disappears again and undergoes precisely the same changes as those which it did for providing the nucleus for the second root-cell, but its counterpart now appears in the protoplasm occupying the lateral projection, which also presents a faint septum dividing it from the remaining part of the fixed protoplasm, in which the primary nucleus is still imbedded.

As the third nucleus, or that of the lateral cell, becomes more defined, and its nucleoli unite together in the way just described, the septum becomes more evident, and at length, we have the lateral cell completely cut off from the first root-cell, and provided with its nucleus.

Vacuoles now appear in the fixed protoplasm surrounding the primary nucleus preparatory to its being broken down into the rotatory form.

*4th stage.*—Here the fixed protoplasm surrounding the primary nucleus becomes entirely broken down by the vacuoles, and the whole of it, blending with the adjoining rotatory portion, now flows freely with the latter, over the septum both of the second root and lateral or rootlet-cells. While this has been taking place, the primary nucleus has moved a little backwards, and has become permanently fixed to the protoplasmic sac, where the cell-wall has also become elliptically dilated, apparently to receive it. Vacuoles make their appearance in the midst of the protoplasm of the second root-cell near its septum; while this cell, now elongated, also gets a list to one side, from the increased development of the rootlet-cell.

The nucleus in the lateral cell now disappears and returns in the way before mentioned, viz. in two parts, each containing two nucleoli.

These undergo the same changes as those before described, ending in

a conjunction of the nucleoli of each nucleus. Meanwhile a longitudinal septum has become developed in the lateral cell, which is thus divided into two, respectively provided with nuclei.

The second root-cell has become more elongated, and the vacuoles have worked a cavity in it, round which the protoplasm is slowly rotating.

The lateral cell has become divided again by a transverse septum, which has been accompanied by a division of the nucleus and quadrisection of the nucleolus as before stated; so that there are now four divisions in the lateral cell, each of which presents a single nucleus with a single nucleolus, respectively formed in the way mentioned.

*4th stage.*—The second root-cell has reached the state of the first previous to the appearance of the secondary nucleus; each of the four lateral cells has become elongated, but in different degrees, as in the case of the roots developed from the root-cell of the embryo-sac; one or two in the latter are generally much longer than the others. Meanwhile the primary nucleus has become enlarged, has presented the vacuoles in its mucus-contents to which I have alluded, and its nucleolus has become divided up into a number of small opaque nucleoli. These disappear and leave the old nucleus in the form of a flat, elliptical, structureless, effete piece of cellulose (?); or the nucleus becomes prolonged backwards in the form of a long cell, and the small nucleoli drawn out with it into different shapes and lengths. What become of the small nucleoli into which the nucleolus divides I am ignorant; whether they become absorbed, or whether they escape from the nucleus into the rotating protoplasm? Judging from what takes place in the cell of the plant-stem, the latter would seem to be their destination; but, whatever it may be, all trace of them ultimately disappears in the remaining portion of the nucleus.

Thus far, then, we have seen, that the second root-cell and rootlet-cell developed from the first root-cell correspond, in development, with the first cell of the plant-stem and root-cell of the embryo-sac. Moreover, when the second root-cell is prolonged, it undergoes the same changes as the first cell, by which repetition, we seem to get further confirmation of what goes on in the embryo-sac before germination becomes evident. All that takes place previous to this, however, is completely shut out from us by the black, opaque colour of the middle coat of the *nucule*, which causes the early part of germination to be as invisible as the glassy transparency of the cell-wall of the root renders its development apparent. Hence, for all that occurs

antecedently, we must be guided by inference, and for views on this part of the subject, I can refer the reader to no higher authority than A. Braun, whose observations on the "Nucleus of the Characeæ" are among the papers which have been so happily selected and translated for the advancement of Botanical Science by Mr. Henfrey.* I would here, however, casually notice that the embryo-sac which turns blue under the action of iodine and sulphuric acid before germination, ceases to do so after the latter has commenced.

It may now be asked, What becomes of the nucleus when it disappears? In reply to which I can state no more than I have already done,—viz. that all it leaves behind is a clear space, corresponding to the form and size of its capsule or cell-wall, with some faint amorphous tissue in the centre, and that this space also soon becomes obliterated or filled up by the fixed protoplasm, after which no trace of the nucleus remains. Its coming into sight again, with its counterpart too, is so faint that it seems almost hopeless to endeavour to trace the changes between its disappearing and re-appearing again,—reduced in size and with double nucleoli, as I have before stated. Of this it is certain, that one part moves towards the free end of the root-cell, viz. the secondary nucleus, and the other part, viz. the primary part, retires from it, while the septum is formed between the two in the lighter space of the fixed protoplasm originally occupied by the primary nucleus before its disappearance. It is also worthy of remark that the part intended for the primary nucleus generally appears first, and its nucleoli unite together long before those of the secondary nucleus; while, although the opposite sometimes takes place, it is rare, for I have only observed it twice.

As regards the influence of the nucleus over the development of the new cells, it will now be evident that, if there be any, it must be derived in the first instance from the parent nucleus, for both the extremity of the second root-cell and the projection for the lateral or rootlet-cell take place before the disappearance of the primary nucleus for providing each of these parts with a new nucleus. But so soon as a trace of the septa respectively, cutting off these cells from the remaining portion of the fixed protoplasm, and, therefore, from the old or first root-cell, is visible, the new nuclei respectively also appear in their proper situations; after which the further development of the nuclei and septa progress *pari passu*. Thus the new cells are never entirely without a nucleus, which would thus appear to exert some influence, directly

* Ann. and Mag. Nat. Hist. vol. xii. p. 207.—1853.

or indirectly, over their development, for as soon as the *only* two new cells which the root-cell gives off are formed the old nucleus becomes effete. At the same time, the general functions of the cell do not depend on the nucleus, for the cell grows larger and the circulation of the rotatory protoplasm continues for an indefinite period after it has ceased to exist; the latter, apparently, with even greater activity than when it was in full operation. Whether a new cell-bud can originate a new nucleus for itself or go on growing to the extent of a nucleated cell without a nucleus, I am ignorant. But I am inclined to the opinion that it can do neither, and, therefore, opposed to the view I formerly expressed, when I knew less about the development of the roots of *Chara*, viz. that the root-cells of *Chara*, like the gemule-buds on the body of *Vorticella*, might be developed "independently of the cell-nucleus."* I should hesitate, therefore, to assert now, that we might state this with certainty even respecting *Vorticella*.

Why the nucleolus should quadruplicate while the capsule or "nuclear utricle" only (?) duplicates, and, when the division of the latter has been completed, the two nucleoli in each half should unite again into single nucleoli, I am also ignorant. That the nucleus in *Chara verticillata* does invariably undergo this process in the providing of nuclei for new cells, several single and several repeated serial sets of observations on different root-cells enable me to assert. So evident is this, that on one occasion the nucleoli of the secondary nucleus remained separate for five hours, during which they not only constantly changed their position, but grew larger, so that I thought they would never unite, and therefore watched for the time of their provisioning the *third* root-cell; when at the end of the fifth hour union commenced, and an hour afterwards was complete. Twelve hours after, this nucleolus also disappeared, and about an hour and a half from this time the oblique septum dividing the second from the third root-cell was just visible, with the parent nucleus and its counterpart on each side of it respectively. Can the conjugation of the nucleoli, if it may be so termed, have anything to do with the reproduction or restoration of the size of the nucleus, as in some species of *Spirogyra* and Diatomeæ, where the contents of two cells, which have been derived from an interseptal division of one, unite again to form the spore? The same kind of quadruplication of the nucleolus appears to take place in the formation of the plant-cell of *Chara*, judging from two instances which occurred to me; and in looking for this generally it may

* Ann. and Mag. Nat. Hist.—1856.

be remembered that, whenever double nucleoli are seen in the nuclear utricle of *Chara*, it is a sure sign of this process having taken place, for even if the parent nucleus is ever in such a condition, it is at that time invisible.

On one occasion I found two nuclei with their two nucleoli respectively ununited, in the axial fluid of the rotating protoplasm, while each nucleus was reduced to a clear transparent oblong cell ; and on looking for the primary nucleus in its natural position, as well as for the nucleus of the rootlet-cell, the projection for which was already somewhat advanced, I found that they were both absent, while the presence of vacuoles in the protoplasm filling the projection for the rootlet-cell, which was not yet cut off from the parent, showed not only that this protoplasm was undergoing solution, but, also, that the development of the rootlet-cell had been arrested. No doubt, therefore, remained in my mind that the two nuclei in the axial fluid were the primary nucleus and the nucleus of the rootlet-cell. In these instances, the nucleoli were clearly seen, and they presented the form of spheres filled or lined with a semi-opaque, homogeneous, yellowish substance, in the centre of which, on the surface of each, was a circular hyaline area or vacuole. In the nucleus nearest the free end of the root-cell, whose nucleoli were separated for some distance from each other, a transparent cell round each nucleolus could be perceived, but this was not apparent in the nucleus which was furthest from the end of the root-cell, whose nucleoli were in contact. The position of these nuclei, away from their proper situations, does not seem inexplicable, when we remember the migrating power of this organ, the want of a septum to keep the nucleus of the root-cell in its place, and the vacuolar solution that the fixed protoplasm was undergoing in which they ought to have been imbedded ; nor can the approximated state of the nucleoli in one nucleus and their separation in the other, coupled with their relative position in the cavity of the rotating protoplasm, fail to point out which was intended for the primary nucleus, and which for that of the rootlet-cell. Thus these nuclei, being in the clear cavity of the axial fluid instead of in the fixed protoplasm, afforded a much better view of the condition they and their nucleoli would probably have been in, had they remained in their natural situations ; and the duality of the nucleolus indicating a recent division of the mother nucleus, while the second cell had been provided, left, with what has been before stated, no doubt in my mind, that this must have been the second division of the primary nucleus for provisioning the rootlet-cell.

It is by no means uncommon, either, to find the nucleolus of the pri-

mary nucleus elongate and irregularly sub-dentate at the border, and half an hour afterwards to find it sub-round, and so on to change from elliptical to sub-round successively for several times, as before stated. I have also mentioned the appearance and disappearance of the vacuoles in it, which Nägeli calls "froth" (*loc. cit.*); and the evidence of locomotive power in the nucleus itself, or in what Nägeli calls the "nuclear utricle." I have, however, never seen any granular matter in it, neither have I ever seen any granular matter in the mucus-contents of the nucleus with the microscopic power mentioned, but, like the nucleolus, it presents vacuoles, though this is only preparatory to becoming effete. The nucleolus sometimes presents a grumous appearance, as before stated, but this is generally just before it disappears, and I am not certain whether it does not depend on an increase in the number of vacuoles.

Iodine makes the neucleolus contract and assume a deep brown-red colour, which yields to water. Sulphuric acid causes it to swell up and disappear instantly, leaving nothing but the nuclear utricle behind, unaffected; just as when the nucleolus disappears preparatory to the formation of a new cell. If, however, a weak solution of iodine be first added so as only to contract the nucleolus slightly, the sulphuric acid does not act so rapidly, and then it may be seen to expand under the eye until its outline alone remains visible, with the vacuoles, which do not disappear under these circumstances. I have never been able to demonstrate a capsule round the nucleolus *in situ*, whether young or old, double or single, though I have tried in various ways to do so, from the deceptive appearance which it frequently presents of having one; nevertheless, in the case mentioned where the nucleus was not *in situ*, a transparent capsule did appear to exist round each nucleolus. When the nucleolus becomes invisible or very faint under the action of sulphuric acid, iodine fails to restore its form or render it more distinct; and in no instance have I ever been able to produce the characteristic blue colour of starch in any part of the nucleus.

We now come to the offices of the nucleus, of which nothing more is revealed to us in the development of the roots of *Chara*, than that, so long as new cells are to be budded forth from the one to which the nucleus belongs, the nucleus continues in active operation, but when this ceases it becomes effete; while the rotation of the protoplasm and subsequent enlargement of the cell, &c. which is much better exemplified in the plant-stem than in the root-cell, goes on after the nucleus ceases to exist. Hence the development of the root-cells of *Chara* affords us nothing positive respecting the functions of this organ, and, therefore, if we wish to assign to it any uses in particular,

they must be derived from analogy with some other organism in which there is a similar nucleus whose office is known. Now, if for this purpose we may be allowed to compare the nucleus of *Chara* with that of the rhizopodous cell which inhabits its protoplasm, we shall find the two identical in elementary composition; that is, both consist at first of a "nuclear utricle," respectively enclosing a structureless, homogeneous nucleolus; the latter too, in both, is endowed with a low degree of movement. After this, however, the nucleolus of the *rhizopod* cell becomes granular and opaque, and, when under circumstances favourable for propagation, a new cell-wall is formed around the nuclear utricle, or this is an enlargement of the nuclear utricle itself, I do not know which; the granular substance of the nucleolus becomes circumscribed, and shows that it is surrounded by a spherical, capsular cell; the granules enlarge, separate, pass through the spherical capsule into the cavity of the "nuclear utricle"; a mass of protoplasm makes its appearance, and this divides up into monads, or, as I first called them, "gonidia."* The nucleolus of *Chara*, on the other hand, after having provided the two cells developed from its own root-cell, becomes stationary, and also divides up into a number of small, round, graniform nucleoli, which disappear in some way or other unknown to me, leaving the nuclear utricle, at least, effete. Whether these small nucleoli are ultimately dissolved or find their way into the rotating protoplasm, I am, as I have before stated, ignorant; but, so far as this multiple division goes, we have an analogous termination between the nuclei of these two organisms; and when we remember that the nucleus of the cell in which the *globule* of *Chara* originates must furnish all the cells with nuclei which bear respectively the antherozoids,—that these nuclei are very small, so small indeed that they are but granules in size, compared with the nuclei of the plant and root-cells,—it does not seem far-fetched to assume that the nucleus is an organ of generation.

Further, should it hereafter be proved that the rhizopodous cells are developments of *Chara* itself and not a foreign organism, it might not be found difficult to trace a connection between the so-called "gonidia" and the "spiral filaments." Thus *Chara*, in some forms, would then be an animal, and in others a vegetable, according to the distinction between it and *Amœba* which will presently be mentioned; for the rhizopodous cells do not produce the "gonidia" or monads until they have enclosed a portion of the cell-contents, after the manner of *Amœba* when taking its food. Again, I have already shown how the nucleus of the latter divides up into granules and cells producing new

* Ann. and Mag. Nat. Hist. vol. xvii. p. 101.—1856.

beings, and how it becomes lost in the development of the ovules,* and Stein has shown that the nucleus of *Vorticella* becomes divided up into cells to produce a new litter; also that it shrinks into a small elliptical effete mass of fine granules in the development of *Acinetæ* through the *Acineta-form*, which I have frequently been able to confirm. So that, if the nucleus in *Amœba* and *Vorticella* be identical with that of *Chara*, we shall probably not be far wrong in assigning a generative power to it generally, that is, through duplication in common reproduction and through multiple division in the true process of generation. We must, therefore, if we adopt these views, regard the nucleus of the *globule* as merely a modification of that of the cells of *Chara* generally, to meet the requirements of the case; and hence as a subordinate organ, which, together with the other parts of the protoplasm, is subject to a common developmental power. It has already been stated that the nucleus perishes as soon as its functions cease; while the cell to which it belonged goes on growing. Thus the internode of the large *Nitella* of Bombay, which may be half a foot long, loses its nucleus, probably, when, as a cell, it does not exceed the 100th part of an inch, for the nucleus disappears long before the layer of green-cells is formed.

It has not, however, been shown what becomes of the small nucleoli of the effete nucleus; and perhaps it would be as well not to assume that no more new cells can be formed after this takes place; for, if the cortical layer of cells is ever added to the first internodes and branches of the young plant of *Chara verticillata*, which I have already stated to commence in the simple form of *Nitella*, it must be some time after the nucleus has ceased to appear in its ordinary form or as a whole; for at present I have a dozen plants with the *nucules* attached to them respectively, and each plant about one-third of an inch in length, without the least appearance of cortical cells, although each is composed of three or four internodes and several branches; if the cortical cells appear hereafter, they may, perhaps, be formed like the other cells, viz. by projections of the mother cell-wall, in the form of grooves, which, lodging a portion of protoplasm, are ultimately cut off from the parent cell or internode; in which case they must be provided with nuclei from the remnants of the old nucleolus, or nuclei altogether *de novo*.

While the component parts of the first cell of the root of *Chara* are still fresh in the mind of the reader, it seems advisable that they should be compared with those of *Amœba*. *Chara* lives by nutriment obtained

* This vol. p. 451.

through endosmosis; *Amœba*, by taking in the crude material direct, and, having abstracted the nutritious parts by the process of digestion, throwing off the refuse. *Chara* is a vegetable, though there are animal cells which also live by endosmose, but *Amœba* cannot be a vegetable if we admit the distinction that I have given, viz. the taking in of crude material. Nevertheless the root-cell of *Chara* and *Amœba* greatly resemble each other.

Thus the cell-wall of the former corresponds to the pellicular secretion or capsule of *Amœba*, which, in *Arcella*, &c. appears as a shell. The protoplasmic sac may correspond to the pellicula itself and diaphane. The nucleus is identical, and situated in the fixed portion of the protoplasm, as it appears in the fixed molecular sarcode of *Amœba*, when the latter assumes a spherical form. (In my notes on the organisation of the Infusoria,* I have called the "nuclear utricle" the "capsule" and the "nucleolus" the "nucleus.") The "granules" of the fixed protoplasm have exactly the same greenish tint and appearance that the "granules" of the sarcode in *Amœba* present, and the former appear to be vicarious in function if not homologous with the green cell of the plant-stem, that is, when the former make their appearance the latter disappear. The rotating protoplasm corresponds with the internal mucus of *Amœba*, to which I would confine the term "sarcode,"† and the vacuoles to the vesicula and vacuoles of the substance of *Amœba*; hence it would appear that, as a cavity is formed in the protoplasm of the cell of *Chara* by the bursting of the vacuoles into each other, round which the rotating protoplasm turns, so it may be the vesicula which thus becomes distended in *Amœba* to render it spherical, and hence the appearance of the fixed sarcode on one side of it in which the nucleus is imbedded. That the vesicula, when greatly distended, does render some of the infusoria spherical, may easily be seen by the state in which *Plœsconia* and *Vorticella* burst from their cysts respectively when the vesicula is expanded to the utmost to produce the rent, and then subsiding after the animalcule has effected its escape, thus allows of its returning to its natural form; and it is not unreasonable to infer that the same thing takes place in *Amœba*, to render its plane form spherical, and *vice versâ*.‡ Nor should we omit, in this analogy, the vacuolation which takes place in the protoplasm of *Chara* just before the cell dies or when it is weakened by disease or injury, which is a common occurrence with the vesicula and its vacuolar system in *Amœba* and other infusoria under similar circumstances.

* This vol. p. 446. † *Idem*. See the definition of these terms, p. 429 *et seq.*

‡ *Idem*. See remarks on this point, p. 445.

The most interesting point, however, which this analogy brings forth is the correspondence between the rotatory motion of the protoplasm in the cell of *Chara*, and that of the sarcode of *Amœba* and other infusoria; since, by considering this motion in different organisms, we may perhaps come by some notion of the cause by which it is produced in all. In the Planariæ and Rotatoria, the lash of cilia, which projects from the hepatic cells that line the stomachs of these animalcules respectively, rotates the food during the process of digestion; but in the second part of the alimentary canal of the Rotatoria, where there are no hepatic cells, the surface is seen, on the approach of anything into it, to be covered with cilia. Again, in *Vorticella* and *Paramecium aurelia*, the digestive globules also are slowly circulated round the abdominal cavity, if I may so term it, in the midst of the sarcode or internal mucus; and when we watch this circulation narrowly, to wit, in the posterior part of *Vaginicola crystallina* (Ehr.), we see that the bodies in which the chief motion exists are very minute and apparently stationary, and that, while their movements are very rapid, the circulation of the pellets of food is very slow, hence they would appear to be cilia. The same kind of circulation occurs in *Amœba*, but is so tardy, while this infusorium is so incessantly changing its shape, that it is not seen under ordinary circumstances. The movements of the rotating protoplasm in the Characeæ is also very slow; for, when it is viewed in the long internodes of *Nitella* with a very low power, or even with the naked eye, it seems hardly to move faster than the foot of a gasteropod; still there is no positive evidence that it moves round the cell after the manner of the latter, although it would appear to possess the power of movement *per se*. Hence the question remains undecided, viz. whether it moves round the cell by itself, or by the aid of cilia disposed on the inner surface of the protoplasmic sac, in like manner to those which appear to exist in the abdominal cavity of *Vaginicola crystallina*, and which have been seen and drawn by the Hon. and Rev. S. G. Osborne, confirmed by Mr. Jabez Hogg, in *Closterium Lunula*.*

It might now be said by some that, in the present state of our knowledge, the comparison between a plant and an animal is not allowable; but the answer to this respecting *Amœba* is, that there is nothing on the animal side of this organism that offers for comparison equal to the organisms on its vegetable side, taking it even generally or particularly. Again, it might be said that I was formerly of opinion that the rotating protoplasm circulated round the cell by itself; but I was then not aware of the existence of the protoplasmic sac or a

* Quart. Jl. Microscop. Soc. vol. ii. p. 234.—1854.

fixed membrane inside the root-cell, on the apparent absence of which this view was chiefly grounded. Lastly, it might be said that I formerly tried to prove that the "gonidia" developed from the rhizopodous cells of the protoplasm were the offspring of a parasite, and now I have hinted that they may be found to be developments of *Chara* itself. Proof of the latter, however, is very remote, but when we find that there exists an intimate analogy between the nucleus of the cell of *Chara* and that of this rhizopodous cell, as well as that of *Amœba*, &c. both in form and, probably, offices, and that the nucleus of the rhizopodous cell divides up into granules for the production of the "gonidia" or monads, it does not seem to me an unpardonable amount of speculation to think for a moment that the nuclei of this organism, which exist free and in their proper cells in the protoplasm of the internode of *Chara*, may be derived from those into which the nucleolus of *Chara* ultimately becomes resolved.

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## ART. XI.—*Notices, Historical and Antiquarian, of Places in Sind.* Communicated by H. B. E. FRERE, Esq., Commissioner in Sind.

Read 8th March 1855.

*Oomurkot and its Soda Princes.* By VISHWANATH NARRAIN.

Oomurkot, so named after its founder Oomur, one of the Soomras, was built probably more than five hundred years ago. The Soomras held the place for about a hundred and fifty years, and were succeeded in the sovereignty of it by a warrior tribe, the Sodhas.

The Sodhas (or Sodas) are a branch of the great Parmar race, which has spread, at different periods and in the numerous revolutions of former days, from that cradle of all the Kshatree tribes,—the Province of Central India. Under various names this tribe has from remote times held sway in different parts of Central India and the adjoining countries.

One of these Parmars, named Bahudra (or Bahudrao), lived at Balmeer about 450 years ago. He was succeeded by his son Chhahudrao, who removed from Balmeer to Seew in Marwar. Chhahudrao had two sons, Sodha and Sankhlo, and one daughter, Sichya. The first of these made an expedition against Ruttakot (so called after a Moghul Rutto, its founder), and conquered it. Tradition relates that when Sodha killed

the Moghul Rutto, his head, severed from the body, bounded down twenty-five steps from the threshold of his palace, and there stopping exclaimed, "Your descendants shall reign for only twenty-five generations," a prediction which the people of the place (Oomurkot) consider fulfilled, inasmuch as they make out a list of twenty-five princes of the Sodha dynasty from the first Parmar Bahudrao.

Sodha, after taking possession of Ruttakot, transferred thither his seat of government from Marwar. The ruins of Ruttakot are still to be seen on a sandhill which forms an island in the Eastern Narra, about twenty-five miles NW. of Oomurkot, and ten SE. from Khipra. It is between two small hamlets of Dilyear and Bhaeetee-ki-Bhit, and about three miles from each. The only remains are heaps of burnt bricks covering a large mound. The bricks are of great size, fourteen inches by nine, and proportionately thick. Perhaps excavations and future research may bring to light in Ruttakot a second Brahminabad.

Sodha, as we said before, had removed his seat of government to Ruttakot, which was subsequently given up for Oomurkot, where they displaced and succeeded the Soomras about 350 years ago.

Sodha left his throne and possessions to his descendants, who, after his time, were no longer known as Parmars, but Sodhas or Sodas. The following is a list of Sodha Princes at Oomurkot, as found on the books of a local bard.

The first part gives the three Parmar princes, viz. the grandfather and father of Sodha, and the chief himself; and the second, Sodha and his descendants.

I.—*Parmars.*

1. Bahudra (or Rao).
2. Chhahudrao.
3. Sodha Rao. *

II.—*Sodas at Oomurkot.*

1. Sodha Rao (the same as above 3*).
2. Chachuckderao.
3. Je Brumhurao.
4. Jeshudhrao.
5. Someshwur Rao.
6. Dhara Yureeshe Rao.
7. Doojunsul Rao.
8. Khirorao.
9. Avutarnde Rao.
10. Thero Rao.
11. Humeer Rana.
12. Veeso Rana.
13. Tejsee Rana.
14. Champo Rana.
15. Gango Rana.
16. Soortan Rana.
17. Ashkurn Rana.
18. Kesursing Rana.
19. Khimraj Rana,
20. Sugram Rana.
21. Shrivraj Rana.
22. Subulsing Rana.
23. Mehraj Rana, now living.

The Soda princes were at first called Raos, but the title was changed in the time of Soda Humeer, who had the title of Rana bestowed on him by the celebrated Akbur, who was born near Oomurkot during his father's flight towards Persia through Sind and Affghanistan. The title has descended in the family to the present day.

Although the Sodas have, since the founder of their dynasty, retained a hold over Oomurkot and its surrounding districts, the sovereignty passed through different hands in later times. Thus, in A. C. 1746 Noor Mahomud Kalhora conquered the Sodas, and established his supremacy there. He demolished an old fortress and erected a fort. It stands on a sandhill on the edge of the desert, overlooking the vast plains of Sind, which extend from this spot in one unbroken level to the Indus, a distance of from eighty to a hundred miles. The fort is at present in a very dilapidated condition. The traces of a canal, by which, it is said, the stones for the fort were brought from Southern Sind, are still to be found on the plain below the fort. The stones, many of which are still covered with oysters and barnacles, are of the arenaceous limestone, and limestone conglomerate, common in Lower Sind. The canal is said to extend to Wanga Bazar, and probably communicated with the Lukhput Kharee.

About half a mile NE. of the fort is still shown the spot where the Emperor Akbur the Great was born, as tradition states, in the open air under an "akh" bush *(Asclepias gigantea)*, the only shelter his parents could find in their flight. "There *could* be no doubt of the fact," our informant, an intelligent old Sindee, stated, "as there was the 'akh' bush, and the emperor's name was Akbur," though etymologists will perhaps hardly agree with him; and, as the Ranas of Oomurkot assert that they obtained their title as a mark of the emperor's gratitude for hospitality shown to his parents at the time of his birth, they were probably not quite so destitute of accommodation.

During the time of the Kalhoras, the Sodas had charge of the revenue collections, the Kalhoras contenting themselves with a mere controlling power. One of these latter, Abdool Nubee, fell out with the Talpoors, and, himself unable to be avenged on them, sought assistance from the King of Cabool, to whom the country was then tributary. The consequence was the despatch of a large force from that quarter, which devastated the country, and returned without accomplishing anything. This is said to have been in A. C. 1782. During the same year another force from Jodpoor, where Rana Vijayasing then reigned, came at the invitation of another Kalhora prince; but, instead of

helping the Kalhoras against the Talpoors, they took possession of Oomurkot in their own king's name.

Oomurkot thus remained subject to Jodpoor until A. C. 1813, when the Talpoors attacked and conquered it. This happened at the time of Meer Kurum Alee Mahomed Alee in Sind and Raja Mansing at Jodpoor. From the Talpoors the birthplace of Akbur has, of course, come into the hands of the British, with the rest of Sind.

The population of the Oomurkot Talooka appears from the last census to consist of 20,485 souls. The number of houses is 5,045. Oomurkot itself is a small Thurr town with 556 houses, and a population of 2,755 inhabitants. The style of houses is such as generally prevails in Sind. They are mud-roofed and very poor looking, and the streets very dirty. The beehive-shaped hut, which is universal throughout the desert, is seldom seen in Oomurkot itself, though common in the neighbourhood.

The majority of the people of Oomurkot are Hindoos. Their style of dress is nearly a mixture of Marwaree and Sindee; as also their dialect, which largely draws upon the Marwaree from the contiguity of that frontier.

Oomurkot is the chief commercial town in the Thurr, trade being carried on through it with Kutch and Guzerat on the one side, and Marwar on the other. The principal staples are cotton and grain, but there are also various native dyed stuffs dealt in in small quantities.

### *The Ruins of Mehmetoor.* By F. PHILLIPS, Esq.

Shahkapoor, anciently called Mehmetoor, is situated in the southern part of the Shah Bundur district, and about ten miles south-east of Meerpoor Buttora, the chief town of the Zillah.

The present village consists of not more than fifty houses, situated on a large watercourse, called the Old Goongra, to distinguish it from the stream of the same name flowing through another part of the country. Close round this watercourse and the present modern village commence the ruins of Ancient Mehmetoor, which extend for upwards of three miles, in a south and south-easterly direction. They consist for the most part of burnt brick mounds of different dimensions, which stand in the plain perfectly isolated from each other, and are visible from a great distance. The largest mound is situated close to the existing village, and is about three hundred yards in circumference, and perhaps sixty feet in height. This has not been opened as yet. In places are seen large blocks of stone, which have, apparently, formed the foundations of buildings, and there is also a small bury-

ing ground containing a few tombs of carved sandstone, put together, as is common in Sind, without mortar. These, however, possess no inscription whereby to judge of their age, or the names of those whose memory they were intended to perpetuate.

From the general appearance of the mounds I should say they are the remains of the principal buildings of the ancient city, the intermediate and more humble habitations of the poorer classes, probably of clay and earth, having disappeared in the lapse of time. There are no appearances of any fortifications in any direction.

Hitherto but few of the mounds have been opened, owing to the small success which has resulted from the operation. The excavations carried out have been made by sinking shafts and carrying the cut along all walls found in the ruins; the contents of the space so included have then been dug up and sifted, but, as already stated, with small results; one silver coin only, lately sent to the Commissioner of Sind, has been found. The other relics consist of fragments of cornelian, agate, and other stones (apparently evincing that many lapidaries formerly resided in the place), and a large number of old copper coins, very small in size, and all so corroded that no inscription or legend, if any existed, is now to be traced; on some of the stones may still be seen faint traces of Arabic character, but not so distinctly as to convey a correct idea of their meaning. Specimens of all these have already been forwarded, and it is intended, during the next cold season, to continue the search, with the view of throwing some light on the history of this place.

The present village is called Shahkapoor, (King's Town), after the famous Kutch saint, Shahfuttoo, who travelled through this part of Sind about two hundred years ago. Of the ancient city, Mehmetoor, nothing positive is known, and the following brief account has been gleaned from personal inquiry among the natives of this part of the country.

Mehmetoor, it is said, was originally founded by Mahomed Pyeem Soomra, the first of that tribe who reigned over Lower Sind. This will, I think, take us back to the fourteenth or early part of the fifteenth century. The city then, the tradition goes, stood on the banks of the Indus itself, and, indeed, the marks which still remain show that the old Goongra, now a nearly dried-up channel, must once have been at least a very considerable branch of the river, if not the main stream itself. The next chief named is Humeer Soomra, who must have been paramount late down in the line. The ruins of his palace, the large mound near the modern village, already alluded to, are still called by his name,

and pointed out by the peasantry. He died leaving two sons, by name Doda and Chumeesa, of whom Doda, the younger, usurped the throne. The elder brother, it is said, on this fled to Delhi, to lay his complaint before the reigning Emperor, Allahooden, and implored assistance. This was granted, and a force sent back to assist in recovering the lost throne. The brothers joined battle about ten miles from Mehmetoor, at a place called Keree, which is still pointed out by the natives. Both were killed in the battle, and the Soomra army totally defeated. The Delhi force, the tradition goes, then marched on and sacked and burnt the city, which never again recovered the blow, and Mehmetoor or Shahkapoor thus ceased to be the seat of power.

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## Art. XII.—*Description of the Caves of Bágh, in Ràth.* By E. Impey, Esq.

Read 28th December 1854.

Upwards of thirty-five years have elapsed since Lieutenant Dangerfield published, in the second volume of the Transactions of the Literary Society of Bombay, his description of the Caves of Bágh, and though it has met at the hands of every antiquarian its meed of undoubted praise, so little has been thought of the Caves themselves that, in all notices and allusions to them by authors, a few lines, and those not without error, have served to fix their situation, number, size, and objects of worship, to all and each of which some amount of correction has become necessary on closer inspection.

Whether the confident but partial references thus made to them, or the unfrequented and secluded situation of the Caves, has deterred travellers from satisfying themselves on the above points, is not of much moment, but certain it is that few persons, beyond the officers of regiments in the neighbourhood, have thought it worth while to judge for themselves, and thus the three largest and, in some respects, most remarkable monastic caves in India have remained almost unknown.

In physics as well as in ethics the first error is in most cases reckoned the worst, and perhaps the geographical position given to the Caves has, more than any other, prevented their being sought for, and misled inquirers.

Whence it arose or with whom is not very material, but Mr. Ferguson and subsequently others have assigned to them the Valley of the Tapti instead of the Nerbudda, which is equivalent to interposing a distance of nearly 100 miles, and in that space a range of Ghàts in which no caves whatsoever have as yet been found; enough, it will be admitted, to deter most explorers, unless well acquainted with the topography of Western India, for I question whether even the name of the town of Bágh is known to a single individual on the banks of the Tapti.

I have not, unfortunately, Mr. Erskine's paper, nor have I seen it for several years; the work in which it appeared (Transactions of the Literary Society of Bombay) is excessively scarce, and out of the reach of reference, being only to be found in libraries; I cannot, therefore, state precisely how many caves he entered or described, but, as well as my memory serves me, he supposed them to be four or five, of which two were said to be in ruins. There are, however, in reality eight, and the remains of another distinct set about a mile distant.

As may be said of all known excavations, none are in a perfect condition; but at Bágh in particular, from having been dug out of a soft friable sandstone, they are in some places very much dilapidated and visibly crumbling daily, which makes it the more necessary that as accurate an account as possible be recorded of them before they are altogether destroyed.

Althoügh, from Mr. Erskine's note appended to Captain Dangerfield's description, there was little doubt of the religious character of the Caves, the names under which they have been described and are locally known, viz. Pánch Pandoo, and, I fancy, still more the representation of five figures instead of eight by Captain Dangerfield, have misled a very eminent authority on Bhuddism (Mr. B. Hogson) into the belief that the Caves were dedicated to the Pánch Buddha Dhyàni of the Nepalese—the celestial and exalted but quiescent Eons of Adi Buddha, which I take to be equivalent to as many principal attributes of the Supreme Being. But, independent of differences in detail, the images of the five (at least four) Dhyàni Buddhas being always placed in niches opposite the cardinal points at the base of Chaityàs, and their having unmistakably distinctive characters, such as differences in the position of the hands and nature of the particular cognizances and supporters, there is in reality but one, at the most, two figures of Buddha sculptured at Bágh, the other figures being decidedly subordinate, while the object of worship in all the caves, without exception, is the Daghob. The figures on the screens on each side of the vestibule are exactly similar except as to height, and it is the central figure alone which is

applicable to Buddha. Those on each side of him are attendants and Chowree bearers. The two others in the niches flanking the entrance to the Daghob chamber are Dwarpals, or, at the most, Buddhisutwas, who will be more appropriately and minutely described in detail. It is scarcely necessary to remark that the local name and traditionary connection of the Caves with those fabulous heroes, the Pandoos, have no foundation. Setting aside the fact of their era being nearly two thousand years earlier, their images have never, to my knowledge, been met as objects of adoration, and there is certainly not the least resemblance in the figures at Bágh to the qualities the Pandoos are said to have embodied.

In addition to the errors regarding the figures, the size of the Caves at Bágh has also been underrated. The largest is stated to be 80 feet by 60 feet and a 20-pillar cave; it is in reality 94 feet square and a 28-pillar cave, vieing, if not exceeding in magnificence, No. 3 of the Adjunta series, while the two other Vihars are still larger than any others as yet discovered, being 86 and 88 feet square. I give a memorandum of the respective Caves to exhibit this:—

| | | |
|---|---|---|
| No. 16 Adjunta..... | 67 × 65½ | feet. |
| No. 17 ditto ..... | 64 × 63 | „ |
| No. 1 ditto ..... | 64 feet square. | |
| No. 3 ditto ..... | 91 „ | „ |
| Keneri Vihar ..... | 96 × 42 | feet. |
| Bágh ..... | 94 feet square. | |
| Ditto ..... | 88 „ | „ |
| Ditto ..... | 86 „ | „ |

Ellora Derhwara.....110 × 70 feet. This includes the side cells, for which at least 18 feet should be deducted, which leaves 92 feet, and reduces it to less than the Bágh Caves, besides being a combination of a Vihar and schoolroom, which at Bágh are separate and distinct.

It will be admitted that there are in the above discrepancies sufficient to warrant a second description of the Bágh Caves, notwithstanding the lapse of a quarter of a century; the more so as they are remarkable for a completeness and grandeur almost unknown in any other series, not excepting Adjunta. Of these I may mention evidences of a colonnaded verandah 220 feet in frontage length, and a dome or centring in the chief Vihar, an entirely new feature.

The following will not therefore, I hope, be regarded as a critique upon any preceding account or notice of these Caves; and if I have occasion to refer most frequently to Mr. Ferguson, it is because he is

the latest, the most eminent, and, generally, the most correct writer on Indian architecture, Buddhistical in particular, and by his inability to visit the Bágh Caves there has passed the most favourable opportunity of being recorded the best illustration and most graphic account which a close intimacy with Buddhistical research could produce, instead of which, in the text which accompanies Mr. Ferguson's illustrations, half a page only is devoted to Bágh.

With the exception of the Caves being placed in the Valley of the Tapti, the topographical description of them, as originally given by Lieutenant Dangerfield, is very accurate. The Purgunna and town of Bágh are situated in the district of Ràth, a hilly tract of country below the Vindhya Chain, constituting the intermediate steppe, both in point of elevation and geological formation, between Malwa and Guzerat. It is about 850 feet above the level of the sea, and as many below the range in question. The town from which the Caves derive their name, as understood by Europeans (for they are commonly known as the Pânch Pandoo by natives), is in lat. 22° 26′ N., long. 75° E., and is remarkable for nothing else except some iron mines, rich in ore, but undersold by the same metal imported from Europe. It has for some years belonged to Sindia, who manages it by deputy. Perhaps the only additional point of interest connected with its locale is it accessibility. From Oogein it is between 90 and 100 miles distant, and the same from Indore, to which the road runs *vid* Dhar and the Tanda Ghàt, that is, for travellers going westward. In coming from Khandeish or Nimar it is about 60 miles off the direct road, whether approached from Julwana near Sindwa, at the top of the Satpoora Range, or from Akbarpore on the Nerbudda. In the former case the route is *vid* Rajpore and Chikulda, and in the latter by Dhurumpooree and Bakaneer to Chikulda, towns and places well known in the neighbourhood around.

From the town of Bágh the Caves are distant between two and three miles, on the NW. face of a low range of hills rising from the bank of the Ooree Wagree river. These hills deserve a little notice, as it is to their peculiar constitution the destruction of the Caves is owing. They are the first and only indications of the sedimentary rocks met in this direction below and close to the Vindhya Range, which is entirely volcanic, and they do not extend above a very few miles in length and breadth.

Imposed on the older red sandstone, they are themselves composed of layers of the soft and more recent formation of the same nature, varying both in colour and hardness according to the degree of im-

pregnation with iron, which seems to have imparted firmness and consistence wherever it has intermingled with it. This it does not seem to have done generally in beds of any depth, but in patches and layers and veins in a variegated way.

The colour of the sandstone is consequently in some places as dark as copper, in others but slightly reddish, which is the hardest and finest variety, and also lies *superior* to the pure white, which is soft and coarse and underneath.

Superimposed on the sandstone is a deep stratum of white clay or claystone, in places full 20 feet in depth, and it is evidently owing to the absorbent and retentive power of this clay, and the weight as well as the destructive effect of the water contained in it, that such immense flaky masses of the roofs and verandahs have been precipitated and fallen in. This does not appear to have acted on all the Caves alike, both from the unequal depth of clay, and the texture of the underlying stone, which seems to be most compact in the first Cave (hence its preservation), and least so in the last and most southerly; but, as stated, to this element alone is to be attributed the damage and injury the Caves have sustained.

The hill is about 150 feet in height in the most elevated spot, which is over the first Cave, and its direction E. 40° N., that is nearly NE. and SW.; the aspect of the Caves is consequently NW., making allowance for their sweep, which follows the course of the river or stream, from which they are nowhere 100 yards distant. The light, therefore, which they received was not at any time the full force of the sun, which is never to the north in this latitude beyond a very few weeks in the year.

The Ooree Wagree river is a tributary to the Nerbudda, and though of considerable width where it debouches into that river, is very insignificant at Bágh, except in the monsoon. In the hot weather it is said to be quite dry, and there do not appear to be any reservoirs or bunds in the course of it from which the monasteries could have been supplied.

The Caves, like most others, are excavated right in the centre of the hill's face; that known as the first (and of which a drawing is given by Lieutenant Dangerfield), but that only, is approached by a flight of steps broken by a little constructed parapet. The former commence about thirty paces from the bank of the stream, and are now flanked by large tamarind and bale trees.

The series consists of three large Vihars with their usual cells, but each Vihar has also an attendant set of dwellings larger than the cave

cells, and differently arranged, which seem to have been meant for titular superiors or elders. To the central and chief Vihar there is, in addition to the above (in one continuous façade 220 feet in length and embraced by the same verandah) a large Shala or schoolroom 94 feet long, with which the large and peculiar Caves referred to are connected by a wide passage and doorway. These will be best seen by turning to the ground-plan, and evince not only the peculiarity but the magnificence and completeness with which the Caves were finished. There is, besides the foregoing, a large detached Griha about a quarter of a mile to the south, which I accidentally fell in with.

The set do not occupy an unbroken line or present a continuous front, but are interrupted by curves and bends in the hill which would seem to have been unequally favourable for excavation, and this would almost suggest the idea of successive operations. The actual frontage in feet is close on 1,000, extending over a mile in length, including the Griha or superior's cell to the extreme south.

Commencing with the next to this, and usually the first entered, it would appear, from being hidden from below by trees, to be deep in the hill, and to have been excavated disadvantageously under its face, which is only 25 feet from the uppermost step; but this is deceptive, for there are distinct vestiges of an outer verandah and vestibule, which must have approached the verge of the landing-place, and been originally visible from below.

The front of this Cave is a good deal blocked up with the fallen fragments of the roof of this verandah, and the entire left half by a modern Byragee's Chabootra. There are, however, still remaining several bases of pillars at given distances, indicative of the existence of the former, also the chapels at each extremity.

Still exterior, however, even to the verandah, are the remains of the vestibule or porch in the centre, and at either end a small recess; that to the right contains a very modern figure of Gunesh, but, to counterbalance and display the posterior occupation of the lower chamber indicated by this, there is above it the Buddhistical emblem, the arched dome and spire, with flying figures holding garlands. On the left the primitive figures are intact and more in detail. There, Buddh is seated on a bench with one leg (the left) under him, the other bent and the foot on the ground, the right hand on the right thigh with the elbow bent, the left on the thigh of the same side but straight along it. On either side of him are traces of Chowree bearers, and above him the emblem as in the right. These recesses were evidently the outermost sculptures projecting beyond the verandah, and do not appear

to have been connected except by a raised flooring. The chapels belonging to the verandah, on the contrary, have had pillars lengthways between them, the bases of several (6 feet apart and the same in diameter) being plainly perceptible among the *débris* of the roof.

The exterior plan of this Cave, therefore, differs from those at Adjunta in having recesses exterior to the verandah, which itself has been a colonnade, and these must be added to the ground plan, as will be noticed on referring to the latter; the other Vihars at Bágh are precisely similar in this respect.

Instead of two doors, as has been imagined and described by Lieut. Dangerfield, there have been five to this Cave, which must have afforded ample light to the interior originally, though at present the left half is obstructed by the Fukeer's Chabootra referred to; this is quite perceptible from the interior.

The centre door is 13 feet × 11 with five lintels receding to 10 × 5½, the inner round; at the base have been two tigers couchant. The side doors decrease in height and size, as they are distant from the centre, to 8 feet × 4 in width. The centre door by its height and width must have thrown the light full on the vestibule, its screens, and the Daghob, and also the central hall. The next door, being between the fourth and fifth row of pillars, lit them, while the side door performed that office for the aisles and entrances of the cells and side chapels at the extreme end; there was, therefore, no imperfection or want in this respect.

The front of this Cave has been roughly plastered over but not ornamented in any way, and the only part which has been is the roof, hall, and aisles, now defaced with smoke.

The interior of the Cave is 88 feet square, and its plan corresponds with that of Buddhistical Vihars generally. The aisle, 12 feet wide, runs entirely round, leaving a central space of 64 feet; a platform is raised on the border of this, 6 feet in width, on which six rows of pillars (each way) are erected (counting the corner ones twice), with corresponding pilasters on the side walls, making it a twenty-pillar Cave. The central area is about 50 feet square, and is here occupied by four round pillars, reeded spirally, and considered necessary, I presume, in consequence of the softness of the roof, but so far not singular that No. 11 of Adjunta has a similar arrangement.

On the top of the pillars a cross raft or beam is cut about a foot in depth. The roof of the Cave is consequently so much higher absolutely, and by descending a step into the Cave, and the platform pediment of the pillars only extending over their diameter, nearly 3 feet is added

to the actual height, which is 14 feet, the pillars being 11. This appearance of beams and rafts would give the idea of its having been borrowed from some wooden or structural edifice, and that either of two stories or of flat construction.

The pillars in these Caves all differ, but are traceable to one prevailing idea, viz. varieties of the square, except those in the centre, which are round. In cave architecture the usual divisions of a column are for the most part so indistinct and so lost by the ornamentation that it is impossible to fix a diameter, but, taking as the shaft that which has the largest proportion of the height of one form above the plinth, the diameter would be 5 feet, and higher up about 4 feet. The entire height being 11 feet, one bears no known proportion to the other.

The general order is a small pedestal of one foot in height, consisting of the plinth, one moulding (a torus), and cornice; upon this a low shaft rises by a square 3½ to 4 feet in height, which then changes to a dodecagon for 3 feet, is succeeded by a spiral reeding for 1½ foot, and again by a dodecagon for 1 foot: above this latter is the abacus, on which are imposed bracket architraves which reach in space to one half the diameter. The intercolumnation (if such it can be termed) is therefore as nearly as possible pycnostyle. There are of course deviations from the above, but always in, upon, and above the square part or shaft; for instance, above the reeding are polygons changing to dodecagons, or else the reeding is omitted and octagons and polygons vary the effect.

There are twenty cells in the Cave, seven on each side and six in rear, inclusive of the verandah chapels; they are 9 feet square, have jambs and a recess cut in each in the wall; each cell corresponds to an intercolumnation, and one to the aisle at the four corners. In the rear centre the vestibule leading to the Daghob chamber occupies the space of three cells. This vestibule is 26 feet by 12, open in its whole length, with the exception of two plain octagonal pillars in front. It is in the vestibule that the colossal figures are carved: as they require descriptive detail, I proceed here with the plan of the Caves.

Leading from the centre of the vestibule is a large doorway 15 feet × 6, directly opposite to which, within a chamber 20 × 18 and 17 high, stands the Daghob, or object of worship. It is taller and larger than in most caves, and has a hexagonal plinth for one-third of its height; above it a circular band of about 4 feet and 28 in circumference is cut, and from that the dome springs surmounted by a Tee which touches the roof. It is plain, that is, not ornamented with figures of Bhooda or inferior divinities, and merely interrupted by a few astragals, &c.

In the side walls of the chamber, at 9½ feet from the ground, are long low recesses—receptacles, most probably, for valuables.

From one of the left-hand cells of this Cave a series of chambers, of which five remain, have evidently led up to the top of the hill and been the private entrance. The extreme length of the excavation of the Cave in the depth of the hill is 150 feet.

For all distinctive purposes the drawings of Captain Dangerfield, of the figures and screen of the vestibule, are significant of the general nature of the sculptures, but, as far as my recollection serves me, they give indefinite ideas of the individual characters of each. There are two groups of three figures forming a screen at each extremity of the vestibule, and also a figure meant as Dwarpal, or warder, on each side of the doorway or entrance to the Daghob chamber. These latter differ from one another as well as from the groups of the screens.

The latter are coloured and cut in *alto relievo*, and resemble one another so closely that one description will suffice for both, as the actual differences are very slight.

The figures on the left-hand screen are about one foot smaller, are better carved, and look inwards towards the Daghob, those to the right outwards; all are clothed and cut in a recess which encircles the group. They are raised a cubit from the ground, and, besides this, stand on an expanded lotus which adds half a foot more to their height.

The centre figure is the tallest, 9½ feet to the top of the hair in addition to the foregoing measurement. The right-hand figure near him is 8½ feet, and the left 7½. The largest is evidently a Buddhisutwa expounding doctrine; he is in the same attitude exactly as in the side screens of the Chaitya Cave at Keneri, standing erect, his right hand extended, its palm open, and the body half turned to the observer, while the left is bent upwards upon the shoulder of the same side, and holds up his garment, which falls in folds down his side, crossing at the ankles. The same figure is seen on the Stambhas at Sanchi.

His hair is short and curled, his face contemplative, with a short neck, and pendent earrings not touching the shoulder, which Jain images most frequently do; excepting this there is no trace of ornament about him. The side figures are undoubtedly attendants, and differ materially from that of Buddha; their clothing does not reach to the knee, and they have a profusion of chains and ornaments. The hair in one is loose over the neck, in the other covered with an ornamental pointed cap, and they carry a Chowree and fruit in one hand; they are, besides, inferior in size. The right-hand one, besides the

Mughut, which is almost Hindoo in character, has two necklaces, a profusion of chains in the position of the Janwee, and a rich girdle and bracelets; one hand holds the Chowree, the other rests on the thigh over a knot of the Cummerbund, which passes across the thigh and falls in the shade of the left leg, which is advanced.

The left figure is smaller, and holds, instead of the Chowree, a bunch of fruit,—a Seetaphul or Sureepha,—has bangles and a necklace, but no other ornament, and the hair hangs in ringlets over the shoulders; the waistcloth passes from behind over the left forearm.

The tableau on the left side is similar, each statue resembling its opposite with the exceptions stated, viz. being a little shorter and looking towards the Daghob. Both seem to portray a Buddhisutwa exhorting, the idea most probably which was meant to be conveyed to those entering or departing from the object of worship (the Daghob), which, contrary to custom, is not in a Chaitya or temple, but in a Vihar.

The figures flanking the doorway of the Daghob chamber stand in vaulted niches, and differ from the others in many respects. They appear to be Buddhisutwas also, and while they have the ornaments of attendants, they have no emblem of servitude, as Chowries; on the contrary, one has the "lambent flame of sanctity" expanded behind his head. This is the right-hand figure, and, save in the head-dress, is without ornament. The palm of the right hand is extended, and the cap, which is elaborate, has a seated Buddh surmounting it. The ends of his locks fall on his shoulders, and he stands on an expanded lotus 8½ feet high, and is clothed from the waist only, the dress being gathered behind as Hindoos wear it in the present day. The left figure of the same size would resemble an attendant, but the attitude is not servile or that of a warder, and the open disk or glory is behind the cap, has a seated Buddh in it also. The ornaments, which are in profusion, are handsomely wrought, and the cloth is opened out and spread over both limbs; the right arm is broken, the left on the thigh; the attitude is that of attention.

The peculiarity of this Vihar consists in the combination of the Daghob worship with a monastic residence. In most Vihars the figure of Buddha is either the sole object, or it is associated with the Daghob, being carved on its surface; but at Bágh the Daghob is evidently the emblem and Buddha subordinate everywhere, and figures of him only met with at the approach to the Daghob.

In plan, the peculiarities are central, supporting pillars, which are not very usual, but indispensable here from the nature of the rock, and a

recess and porch exterior to the verandah pillars, which had the effect of lengthening the frontage and showing it to more advantage.

Cave No. 2 is evidently a monastic dwelling, and has never been meant for any other purpose, having neither Daghob or figures of Buddh anywhere. It has fourteen cells arranged in a peculiar manner. The general plan is a central space with the remains of sixteen pillars without aisles; the cells are excavated in the rear and sides.

On the left, four cells lead from a passage which runs round a larger and central one, and gives the idea of being intended either for particular sects or for a superior and pupils, as if supervision was required to be exercised, for a degree of superiority is evidently admitted in the arrangement.

The Cave is apparently an appendage to the preceding Vihar, and from its design must have been excavated either for novitiates (Pattijana),—those of the first grade (vide Mahavanso, chapter xvii.), who had not attained sanctification, or a sufficient degree of it to entitle them to cells in the Vihar,—or else for the accommodation of some particular or higher class of the priesthood. The probability of the latter consists in the finish that has been given to the ceilings of the cells and frontage of the Cave, though the traces of these are only visible in the present day. Whichever may be the solution, the Cave is unlike any other known.

It is not connected directly with any other, but is not far distant from the first, in fact only a few paces round the projecting shoulder of the hill. There is a slight ascent and descent to it, indicating that a portion of the hill has fallen in.

The front of the Cave has not had a verandah, and exhibits decoration in the rock which must have been external, the surface is smoothly chiselled (not plastered), and a row of tigers' heads, excessively well executed, is cut in relief between the usual arched emblem of Buddhist caves. Above these is a course of pointed merlins, more like in miniature the aronaded parapets of Indian forts or heraldic Urdee lines.

The Cave itself is a parallelogram 60 feet × 40 and 15 feet high; it is quite plain, but has been roughly plastered. There have been six octagonal pillars for the support of the roof in quadraple row with corresponding pilasters; two only remain entire.

The right side is occupied by four cells of the ordinary size (9 feet square); on the left is the arrangement referred to. Two small pillars 8 feet high form the entrance to a verandah. In the centre of this is rather a large isolated chamber 11 feet square, on either side

of which runs a passage with doors opening from it with two small cells, making a series of five in one compartment. The same order occurs a little further on in continuation, and this causes one side of the Cave to extend laterally beyond the proper front or entrance.

The ceilings of the passage have all been decorated with paintings shaded in black and white. In the verandah the mosaic patterns prevail, and frets with handsome scrolls; in the large cell a circle almost obliterated, in the angle left by which some chaste figures are well delineated as it were in the clouds.

At the extremity opposite to the entrance of this Cave are three doorways unfinished, the centre large and wide, the side ones smaller. They lead into an apartment 50 feet long by 56 broad, with four rooms of broad, square, rough unfinished pillars, evidently in a preparatory stage. It would appear as if this was an after conception, and the work of a succeeding age, for the rest of the Caves has evidently been complete, as much as there was any occasion for at the time. The united depth of these excavations in the hill is 126 feet, not reckoning the extended range at the side. They have suffered very much from the decomposition of the rock, the sandstone being coarse and loose, with no binding element in it.

Cave No. 3.—As the hill exists at present this Cave is several hundred yards distant from the foregoing, and, judging from the lowness of the scarp and its gradual slope, was never otherwise,—I mean, that no intervening cave existed. There is a path across to it through the brushwood, but the general, and, I fancy, the proper approach is from below and in front, though it is also blocked up with fallen rock and overgrown with wood, which deprives this beautiful Cave of even the remnant of its once splendid architectural front.

It is the largest Cave of the series, 94 feet square, and is remarkable in many respects; it is better lit, the pillars are more elegantly proportioned, and the paintings are superior, more elaborate, and more diversified.

The object of worship is the Daghob in its proper chamber, but without a vestibule; the figures of Buddh are consequently, I presume, painted colossal on the sides of the pillars nearest to it.

To add to the peculiarities there has evidently been a dome in the centre of the hall, and originally constructed too, for the light medial supporting pillars, though on the same foundation, are four feet higher than those in the colonnade, and are surmounted and connected by a circular frieze or screen (a segment of which remains) several feet above the heads of the pillars, and on a level with the upper edges of this frieze are

the tops of other four square constructed pillars inside the former (altogether 8 feet above those of the hall); on these the dome has rested. The inference so far is justifiable.

Connected with this Cave (in one unbroken front, which originally was covered with paintings uninterruptedly) is the Shala or school-room, 94 feet in length, with (at each extremity) corresponding verandah cells. Independent of these and the continuity of the paintings, the soffit of the verandah indicates that these two caves, each upwards of 90 feet long (exclusive of the space marking the partition wall), were included in one splendid colonnade 220 feet in extreme length, and connected by twenty octagonal pillars 14 feet in height. Such magnificence is unrivalled and unequalled in any known Vihar; a pilaster at each end and one pillar at the south are all that remain of this superb façade.

The first object noticed in the present approach to the Cave at its extremity is a colossal figure of Buddh, cut in relief in the face of the rock a few yards from the end of the verandah; it is in an arched niche about 13 feet high, in the position of Wiswakarma in connection with the Daghob at Ellora, *i. e.* on a bench, with the left elbow on the left knee. The left arm has an ornament or Bajoola on it. The right arm is worn away. There is an open Makara's mouth behind his neck, and portions of a riband are seen on the shoulders; above the head of the figure are remains of a Daghob, with a triple umbrella and two flying images at the side of it.

A few yards further on there is a little recess corresponding exactly to those in the first Cave, and the arrangement would appear to be precisely the same, viz. first a clear landing-place with a recess at each extremity, and over them figures of Buddh in a particular attitude, then the colonnade of the verandah proper, embracing in this instance two caves. At each end of the verandah a cell or side chapel, and then the principal front of the Cave, with its doors, windows, paintings, &c. The landing-place is here flanked at the north end by the colossal figure described; at the south by five erect figures not quite so large, and too much defaced to be more than traced.

In the exterior recesses are two figures of Buddh seated close together on a bench, the hooded snake over the right one. The walls are painted with eight rows of diminutive Buddhs, within pointed canopies; over these, within an archway, are the remains of another seated figure of Buddh, having the Chakra, or praying wheel, beneath him between two antelopes' heads, and flying garland bearers above. This recess borders on the pilaster, which is connected with the colonnade of the

verandah. It is more handsome and rich than that at the opposite end, where a pilaster and one pillar remain standing, and it is just possible that those opposite the Vihar were more ornamented than those of the schoolroom, which are plain octagons (plastered) on a plinth of the same, and 11 feet high to the architrave. This and the excavation of the roof above it give 14 feet as the height of the verandah through its length. From the portions of it which have not fallen in, the roof would appear to have been painted in fret patterns. It is 10 feet wide and 220 feet in length, the intercolumnation 6 feet, and the diameter of the pillars 3½; at this calculation, and allowing 18 inches to each pillar for the mouldings for the pedestals of the columns, there must have been twenty pillars at least in the façade, a magnificence which has few (indeed, I am aware of no) parallels in any series of Buddhistical caves in Western India.

The above length is unbroken, and made up of the fronts of two caves 94 and 90 feet long, each with a partition or interspace of 36 feet interiorly. It has been plastered and painted continuously through its whole length in double rows, one above the other; portions of the upper only remain, and even these are scribbled over with names, &c. As the paintings require separate description, it may be more convenient to return to them hereafter.

The internal measurement of this Cave is 94 feet square with twenty-eight pillars; the aisle is 12 feet broad, and the number of cells twenty-four; one, as is customary, opposite the intercolumnation and at the end of each aisle, and six in rear, in addition to the verandah chapels. These cells are 9 feet square, with a recess and hole for pegs. There is no vestibule, however, and the Daghob chamber is small, approached, as usual, by a high door 11½ feet by 7. The Daghob itself is diminutive and plain for the size and finish of the Cave, which strengthens the idea of there having been a larger and principal one under the dome. This latter would not be at all out of place, it being the original plan of the Ceylon Vihars, according to the Mahavanso, and also the custom of the Nepaul Buddhists, a later and less orthodox sect. The pillars of this Cave are much higher and in better proportion than in the first, being 11 feet high by 3½ feet in diameter. They are subdivided less massively, changing from the square to octagons and polygons, and returning to the octagonal form again up to the abacus. The architraves are half a diameter long, and the intercolumnation 6 feet—nearly two diameters. The sandstone has been too soft and unfitted for sculpture, its place has consequently been supplied with the kindred science—painting—everywhere, except in the brackets, which, near

the chief door and there only, are carved with figures. On the outer face, figures of lions and tigers ridden by Buddhisutwas, and on the inner, elephants in different attitudes similarly mounted. This is confined to the front row of pillars at the entrances to the Cave and the corresponding pilasters, on one of which is a true Nandi, undoubtedly original and coeval with the Cave. Except at Sanchi and Nassick (the latter of which I shall prove is a copy from Sanchi), I do not remember to have seen it so conspicuously associated with Buddhistical excavations,—certainly not in those of the latest date.

This Vihar derives its light from five apertures, viz. one large door in the centre flanked by two windows, and these by two doors. The last are opposite the side-aisles. The chief door is excessively handsome and well finished, but the rest are scarcely less so. It is 15 feet high, with five pilasters, and 8 feet broad, retiring into 9 feet by 6. The cornice of the door is ornamented with a row of nine Buddhist figures in different positions, and a miniature Daghob at each end. The frieze has a course of heads of Buddh, and the architrave a scroll of roses tournante which pass down the inner pilasters. The consoles are charged with a small female figure having one hand, resting on an infant's head, both standing within an open Makara's mouth; the pilaster underneath being worked in elegant scrolls.

The other doors have much the same ornamentation, and in their general proportions are architecturally correct, their height being double their width. The windows are nearly square, and have on the inside holes for the sockets of wooden closings, and also for a bar to fasten and shut them.

The rear row of pillars in this Cave are plain octagons, the inner faces of them near the Daghob have figures of Buddh painted on them, with the glory or halo round his head; he is here seated cross-legged and quiescent.

All the pillars of this Cave, as well as the ceilings and walls, have been plastered and stuccoed with figures and scrolls in mosaic pattern, and string courses of different kinds, divided into compartments containing flowers, fruit, leaves of trees, animals, and birds; interspersed and intersected by borders of various patterns; every spot, in fact, is covered with endless devices.

Above the doors of the cells, all round the Cave, is a handsome scroll 3 feet deep,—I fancy, that which struck Lieutenant Dangerfield. It is best seen on the left wall. It, as well as the rest, is executed in distemper and shaded in black and white merely, not so fine and broad as chiaroscuro, but still evidencing a high degree of perspective

and of art, which, it may be presumed, was of foreign origin, as little trace of it remains among the present races of India.

The central enclosure, or hall proper, of this Cave, is that which characterises it so strongly. It had evidently a dome or centring, which is demonstrated, as much from the outline of the fallen fragments, which lie in a circular form, as from the increasing height of the two sets of pillars which have supported it, as already stated.

The pillars are twelve in number, eight outer and four more central; the former disposed octagonally in pairs,—something akin to the plan of modern Jain temples,—opposite to the third and fourth row, each way of the hall colonnade, and at a distance across of 33½ feet. They rise nearly 4 feet *above* those in the hall, are round, 12 feet in circumference, and are exquisitely carved from top to bottom, differing completely from all the rest, and resembling somewhat those in No. 2 Cave Adjunta, but richer. Above them is a circular frieze 4 feet in height, containing three rows of Buddhists' busts within the emblem, the chief of which encloses a pair, half turned towards each other; the upper and lower rows are faces merely, with the hair made up resembling wigs; the middle one contains entire figures seated cross-legged, the hands resting on the soles of the feet.

On a level with the upper ledge of this frieze, *i. e.* nearly 8 feet above the hall pillars and 4 feet above the last described, are four square constructed pillars, built of cut stone, 5½ feet diameter and 22 feet high, as well as could be measured from the fallen *débris*. They are within the octagon produced by the round pillars, and but 28 feet apart, but the space embraced by the twelve conjointly, having a diameter of 33½ feet, would afford a magnificent dome of 100 feet in circumference, the contents of which it is impossible to conjecture unless it were a Daghob. These constructed pillars are curious and remarkable. They are built of squared sandstone 5½ inches thick and 1½ foot long, without cement, and could scarcely have formed a part of the original design, or they would have been cut from one entire block like the rest; most probably, during the period of excavation, the roof threatened to give way, making their erection necessary. Neither explanation would, however, invalidate the idea of a central dome, as the round pillars are 4 feet above those in the hall, have portions of a circular frieze running around, and connecting them, and are outreached by the constructed pillars, which are 4 feet higher still, making the height of the base of the dome 22 feet, while the height of the roof of the aisle is only 14 feet. It is a remarkable anomaly in Cave

architecture, and doubtless was meant for either a Daghob or image of Buddh, as the usual relic here is insignificant, and out of all keeping with the finish and magnificence of the Cave. Altogether, the external decoration is quite worthy of the splendour which might be expected when a dome of 100 feet is met and a colonnade 220 feet long; and all combine to place it in the first rank of known Vihars. Before describing the paintings on the conjoint front of this and the next Cave it may be as well to give the particulars of the latter, or Cave No. 4.

Though exteriorly within the same continuous front, it is separated interiorly from the last by a partition wall 36 feet thick. It is in shape a parallelogram 94 × 44, has neither aisles, cells, Daghob, nor image, and is perfectly plain and without ornament, though it has been plastered.

There are eight pillars lengthways, 12 feet from the walls in a double row and 12 feet apart; their proportions 11 feet high and $3\frac{1}{2}$ feet in diameter—the nearest approach to any recognised principle. They are very peculiar, and give more the idea of being derivations from Greek models than any I have ever met.

The shaft is round, smooth, and unornamented throughout, springs from the floor, and has no plinth or pedestal, and is uninterrupted to the Cavetto cornice, except by a wide astragal, which would have been a torus if properly placed, and which, from its high position, half a foot from the summit, gives it a sort of hypotra-chelion. The Cave is lighted by one large door and four windows, two on either side, 6 feet square, cut through a very thick wall. It has unquestionably been a Shala, used either as a refectory or schoolroom, or perhaps both, and is the most perfect one I know, for the Dehrwara at Ellora is a combination of a Vihar as well.

At the extremity of the verandah there is a cell corresponding to one at the north end, and a pillar and pilaster of the colonnade already alluded to. Inside, at the south end, is a large door 9 feet by 8, which leads into a passage 18 × 13 feet, at the end of which a similar door leading into Cave No. 5.

This is evidently a dwelling, and in this respect so far resembles No. 2 that it is attendant and attached to the Vihar. It is 46 feet square, and has no verandah; the doors and windows (two), which are of small size, opening out directly into the air. It had six pillars in two rows, of which the capitals and pilasters alone remain to indicate their position and existence. There are five cells in it, three in rear, and two on the farthest side and opposite to the entrance of the schoolroom; they are larger than usual, probably designed for Arhans or instructors. A rough ground-red plaster has covered the walls.

It is between the outer extremity of the verandah of Cave No. 4 and the north window of this Cave that the four figures are carved on the hill, in the space, in fact, corresponding to the passage leading between the schoolroom and it and No. 6, which can scarcely be designated a Cave, for it is a solitary cell without an adjunct of any kind. About twenty yards further on is Cave No. 7, a Vihar, a fac-simile in arrangement, size, and every essential of No. 1. It is 86 feet square, a 20-pillar and 20-celled Cave, but it is so dilapidated and blocked up with fallen roof and pillars that the aisle alone is traversable.

There have been one principal and four small plain doors, and there is a vestibule to the Daghob chamber, but without figures.

The fallen pillars have been plastered and painted as in the large Vihar, but not so carefully or in such variety of colour and shade. It was, however, decidedly finished and complete at one time, though now so much destroyed. Being infested with bears, and occasionally a tiger's residence, it is not very easy or safe to explore it; fortunately from possessing so many points of similarity to No. 1, and nothing novel about it, there is not a necessity for dwelling on it.

From the extreme corner cell of the right side a small intervening cell leads into No. 8, of which only five cells remain, and are quite exposed owing to the hill having fallen in *en masse* close to them. The hill terminates within a very few paces from the extremity of the last cell of this Cave; and the excavators, having small space to work or to carry out any extensive plan, have therefore built up a part of the front with cut stone, and also the backs of the cells of the last Cave when they came close on them.

The remains of this Cave indicate that it also must have been a 20-pillar Vihar; there are three cells in rear on each side of the small Daghob as in caves of that dimension, and also the pilasters of a double row of pillars with two cells between each. Every other part has fallen in, including the roof, and you have to descend considerably to see even this much; the length measured outside by stepping was about 80 feet.

This concludes the series in this direction, but about a quarter of a mile to the north of the first Cave is a large Griha making Cave No. 9, which I came upon accidentally. It is high up in the hill, quite isolated, and has two small pillars opening into a single chamber.

About a mile and half nearer the town of Bágh, on the banks of the same river, and not far from the Griha of an old Vishnavite temple (remarkable for nothing but a well-carved figure of Vishnu on Shesnaga,

with his Gana and Luximee springing from his navel), I discovered the frontage of another Cave, No. 10.

A door and four windows only exist to trace them by, and a space of 10 feet in their front, the rest being blocked up with earth and rock. In all likelihood they were (if ever completed) a repetition of the more finished series; they could never have been lofty, as the hill or bank is very low comparatively in this spot, and I incline to think that this was found to be the case, and that they were forsaken and the attempt abandoned.

The paintings at the Bágh Caves, at least the historical and pictorial part, beyond the mere embellishments of pillars, occupy the entire front of the great Vihar and Shala, which (as before remarked) are included in one, and measure 220 feet in length. At one time the whole front of this has been covered with paintings about the natural height, in a double row, one set above the other, and the surface extent of the work thus elaborately depicted must have been at least 3,000 feet. The design is no less varied; but unfortunately very little remains to elucidate the subjects, as the paintings are very much defaced and scribbled over, and the lower row, independent of being inaccessible from the fallen roof, is almost entirely worn off.

They have been divided into compartments separated by stems of plantains and gateways, and seem to incline to and originate from given centres, which are in some places figures of Buddh seated in an arbor. In others, relics, as his garment, gourd, &c. hung under plantain trees in a garden; and I infer, from the broken detached patches still existing, that either the consecration of these was meant to be represented, or the chief acts of Buddh's life, which were embodied in and formed the substance of the Buddhistical doctrines, as on the gateways at Sanchi, only that, being several centuries later, they evidenced a different state of manner, habits, and society.

The paintings seem to me to have been executed in what we know as distemper, not al fresco, for there is by far too much finish, shading, and detail to be consistent with the rapid execution which paintings on a wet surface renders imperative, and from examination of broken portions they seem to have been done subsequent to the final smoothing of the surface. The perpendicularity of the wall does not appear to have been much attended to in the original and underground chiselling, for the rough plaster is in places several inches thick, in others quite superficial, but over both is an even and finer finish of lime.

The most distinct tableau commences over the southernmost and last doorway of the second Vihar, and extends uninterruptedly over the

partition between it and the next; they were very indistinct until brought out with varnish.

The colours are excessively vivid, with marked contrasts in blue, red, and yellow, amounting almost to the polychrome paintings of the early Greeks, from whom it is possible they were derived; a dark green seems to be the ground generally.

Immediately over the door, from which the best-defined commences, are four seated figures, of a very dark copper colour, the darkest of any in the series. They half face one another in pairs, and are seated cross-legged on blue and white cushions. They are evidently either expounding a doctrine or discussing some point with uplifted hands; the others may be either disciples or listeners. Those on the right have caps on; one square, like those worn by Sindians in the present day; the other coronet-shaped; a child is at their feet. All are profusely adorned with armlets, mankas, the sacred necklace, beads, &c.

The other pair are less rich in ornaments, and one wears the hair plain. They have white and green striped Dhotees, and the lips, eyes, soles of the feet, and palms of the hands are shaded a light slate colour, with very good effect. A sort of balcony separates those on the right from two female figures, one of whom is weeping or resting her head on her left hand in grief; beyond these the paintings are lost in that direction. To the south and left are a group of five seen to the waists; they are also men but differently clothed, having a cloth over the left shoulder, leaving the right arm bare. They are in the attitude of running or hastening to something in advance, the intention being shown by the open extended palms, and by the eagerness displayed in the expression of the eyes and mouth. They are very fair, and the arms, hands, and figures well shaded and relieved; the hair is cut close, and, like all the male figures, no head covering is worn. Below these are five female heads, the figures being destroyed below the bust. One is playing a sitar (very like a modern guitar in shape); the other four of these seem attendants on the fifth or player, who has a head-dress and flowers worn in her hair. The others have their hair in the general fashion of the time, viz. brushed back off the forehead and tied in a knot or ball behind, a piece of ribbon or wreath keeping it together, and being sometimes interwoven with it, reminding one precisely of the women of the Carnatic and Southern India of the present day. In addition to this the women generally have one or two necklaces of pearls or white beads, with turquoise intervening, bracelets and armlets of the same, and

large circular earrings. Their clothing is a pyjama of striped cloth, and when any garment is worn above, it is close fitting, covering the breasts to the neck, and reaching to the middle of the arm.

Dressed and ornamented in this way are two groups of singers and dancers, who are women, one consisting of seven, the other of six figures; each set is dancing around, apparently, a *male* figure clothed in a spotted garment, with his hair in curls over his shoulders, and bound behind with blue and white ribbon. Some of the women are naked to the hips. Each group is tastefully arranged. Some are playing cymbals, others beating time, and one in each group singing. They are painted a light copper colour, the outlines of a darker shade, and the attitudes true; the eyes, mouth, nostrils, &c. of a light green tint, not unbecoming in a drawing; the colours of the clothing are rich and in deep green and yellow stripes.

Separating this from the next group is the coping of a wall angularly placed, and the succeeding tableau consists of thirteen horses with their riders. The animals are all of fanciful colours, crowded together and turning in various positions, but all maintaining the general direction of the cavalcade which is proceeding northward. There is one person only of rank, indicated by a white umbrella over his head, and by being seated on a white horse, which colour appears to have been thus early, as it is still, considered an emblem of superiority with Buddhists. The distinctive mark in one horse is a blue throat tuft, and plume.

The animals are spiritedly painted, and their trappings in those days seem to have been light and not profuse; the reins are fine, and the bits scarcely perceptible, but precisely the same character of breasts and flank ornaments as are used by the natives of Upper and Western India at the present time; the saddles are exactly the native khogirs of this century.

The men are remarkable for being uncovered and without beards, their hair done up much like women's; two of them have it in curls, like those around whom the women are dancing in the preceding piece, but here no distinction appears to attach to it. Their dresses fit up to the throat, and are plain blue and white, or in spots and chequered; One carries a bow, and with this exception they are unarmed. As horsemen they sit easily, and hold their reins indifferently in either hand, chiefly in the right; all but two or three are looking forward.

The next piece consists of six elephants and three horsemen entering a castellated portal, which divides this from the preceding. The lower elephant in advance is driven by a superior, holding an open lotus

flower in his hand; behind him sits an attendant holding an umbrella over him. This elephant, and two others containing women, are the only ones which have jhules on; behind the former are two of the horsemen, one remarkable for having a turban, *the only one covered in the whole series.* The other elephants are jostling and crushing together through the passage, moving along with their trunks curled, and very faithfully depicted,—their tusks tipped with blue, the favourite colour. One old tusker in the middle (taller and larger than the others) has a white trunk, ears, and forehead, most likely the effect of scrubbing, for his body, and what is seen of his back, is of the natural colour. The Mahouts have the ordinary spuds, and the riders of two carry banners. The two hindmost elephants, though driven by men, carry each three women, the two first of whom ride astride, the third on her knees, holding on vigorously by the waist of her antecedent. They wear a close Dhotee, and are otherwise similar to the previous set. The piece terminates with a small building closed by a diminutive door in front. The gables represent the emblem so frequent in caves, of which it is apparently a receptacle.

The next is a peculiar and interesting group, facing exactly the contrary direction, and consisting of four elephants and three horses, which seem to have arrived at their destination. The elephants are at rest, and the Mahouts quietly reposing, their heads on their arms crossed on the crown of the elephants' heads, which animals are looking steadfastly to their front, as are the horses; one of the former carries a checked garment in his trunk. There are two avant footmen with swords and spears. Like the rest, they have their attention fixed on the substance in the compartment in advance, which commences with the famous Amb,bo or mango tree, under which are two small frames or stands containing some drinking vessels and a gourd. Close to these a piece of cloth with blue ends is suspended from a branch, and beside it is a Chakra or praying wheel.

Further on under the shade of a plantain tree is a figure of Buddh, seated cross-legged and clothed, holding the thumb of his right hand in his left, and beside him a disciple listening to the doctrine he is expounding. He differs from Buddhist figures in general in being *without* curly hair, and in this respect resembles the other figures met with. A door breaks the further continuation of figures in this direction, and beyond it the surface of the wall is entirely broken up.

To return to the paintings in the opposite or north direction. They are now in such fragmental portions that it was found impossible to take a connected sketch, and all between the first and central doors are

utterly defaced. The best remnants are near the extreme north door, and even they are not distinct, except a few figures here and there, which are much smaller, though some few are of full length but in miniature. Similar to the other pieces, it has been divided into an upper and lower row, the feet of one resting almost on the heads of the other. The aspect of the representation is contrary to the former, viz. southward, towards the remains of a colossal figure of Buddh, the outlines of which can be traced indistinctly sitting in a garden between the first window and chief door. The commencement of the upper row resembles the healing of the sick: one lean man is sitting and another lying down, their limbs emaciated, while a third seems to be carried before a fourth figure, who appears to be advising them.

Two females next occur in a mourning attitude, preceded by a child in glee; then four dancing figures, and another child running, but looking backwards;—this borders on the figure of Buddh referred to.

The lower row is excessively indistinct, the heads only being traceable satisfactorily; none can be counted: there is one, however, a female with a child at her feet, evidently praying to the figure of Buddh above described. Among the foliage, flowers, &c. surrounding Buddh, one or two contemplative heads are also seen.

In addition to the importance attached to every memorial of antiquity generally, those just described would appear to claim especial attention; ancient Avanti (in which Malwa was included) being inferior to neither Gaya, Ayudhia, Sahrashtra, or Maharashtra as a seat of Buddhism, even previous to the conversion to its tenets of the imperial Asoka, the great captain of that persuasion; for it is indisputable that the doctrines of Buddhism obtained ascendancy centuries prior to the Christian era in Central India. The Mahavanso (of Turnour), chapter xiv. states that six thousand priests, all sanctified characters, from "*Avanti*," attended at the Walukarama Vihar at Vaisáli, and took part in discussing the first heresy, which was put down in the reign of *Kalasoko*, whose era was five centuries B. C., and a century after Buddha's death, which took place 543 B. C. By Central India I do not mean the Aryabhumi of Manu, nor the wide circle described by Fa Hian, including Oude, Benares, Kanouj, as well as Avanti, nor M. Remusat's boundary, scarcely less extensive, but the more modern and conventional tract between 21° and 25° N. lat. and 73° and 80° E. long.

Any one of the Buddhistent remains in this distance presents a field sufficiently extensive for a vast amount of argument and speculation, and the more difficult task of substantiation.

It is lamentable, however, to think, with such an ample store of tradition and history, that so little in reality exists to lead to the recognition of any locality of note, with the exception of Ujayn, and, I believe, Sanchi, a river or two, and a chain of mountains,—monuments of such magnitude and imperishable nature as not to be easily overlooked under any change of power or language. This want of perspicuity in ancient history and geography forces us back upon the only other available sources of information, viz. style of architecture and inscriptions, both of which, unfortunately, in this case are scarcely less reliable.

That any just inferences are derivable from the mere style of Indian architecture, considering its sameness and want of principle, admits, perhaps, less of question than that inscriptions are faultless proofs of the antiquity of particular structures, seeing that the latter are in many instances the handiwork of successive generations, as often almost as of the original architects. It is, however, in no such spirit that I pass the latter over here, but because I repeatedly and diligently searched the Bágh Caves without finding the remnant of a letter, which is not a little remarkable.

In respect to style, the question naturally occurs,—are we in possession of sufficient information on the actual state of art in India in any given century during Buddhist supremacy, that is, from the fifth century B. C. to the seventh century A. D., to decide with precision? Notwithstanding the confident classing and grouping of caves by some authors, I venture to reply in the negative. Perhaps Dr. Stevenson, by his recent translations of the Keneri, Carli, and Nassick Cave Inscriptions, thus according positive data to these excavations, has done more to serve the cause of chronology, to the discarding of argument, than has been effected by conjectural writings for the past twenty years; for it must be admitted that the gradations of Indian architecture, if it can be so called, are so ill-defined (within at least two centuries) as to admit of very imperfect classification, and the diversity on the whole is so little, that the last and first (within given bounds) scarcely differ, for critical purposes at least.

The only author who has pronounced a decided opinion on the age of the Bágh Caves is Mr. Ferguson, and he (evidently from Captain Dangerfield's description, and without assigning any further reason) places them between the sixth and tenth centuries A. D.—an appreciable interval of four hundred years. Independent of certain peculiarities unknown to Mr. Ferguson, I incline to regard even the earliest of his dates an anachronism, and I would place them a century earlier, for reasons which I

shall give. If Shankar Acharya is not a myth, and the Rajawulle (as quoted by Dr. Wilson, in the Transactions of the Bombay Asiatic Society for the year 1853) and the Jejuri legends are true, the limit to the time and power of the Buddhists ceased with him and Khunderao, *alias* Ramachundra, the ruthless exterminators of that sect, about A. D. 620, after which it will be conceded few caves were excavated by Buddhists. But there must have been a preparatory or antecedent period, during which the Buddhist religion, though flourishing previously side by side with the Brahminical from B. C. 263 to five centuries A. D. (vide Mahavanso, and Dr. Stevenson's translations of Nassick Cave Inscriptions), was stationary and even on the wane, the minds of the people being undermined and worked upon for the subsequent change. According to Hiuen Thsien (Colonel Sykes' Notes on the Moral and Political State of India), Buddhism, at the time of his visit in the middle of the seventh century, A. D. 640, was on the decline, and Brahminical temples and monasteries then outnumbered them. It is scarcely to be supposed that at such an unsettled period any great works, such as would have occupied years to complete, would have been commenced or undertaken, even though the impulse was given by so zealous a Buddhist and potentate as Siladitya, King of Malwa, whose hands were, in the seventh century (Hiuen Thsien's period), full of conquest. Apart from this, there is yet no inscriptive authority for caves of such a late period, though probably close analogical grounds for the supposition, while in the two centuries previous great activity seems to have prevailed in this respect. Several caves in Western India, in Nassick, and Maharashtra generally, were excavated A. D. 343, 408, and 428, by the Andra Sovereigns. (Vide Dr. Stevenson, in Bombay Asiatic Society's Transactions, July 1853.)

Ujayeni, or Avanti, about this period, was presided over by a Buddhist prince in nowise inferior in point of opulence or zeal to the Andra King, viz. Chandragupta, under the cognomen of Vicramaditya the Second, and, according to Prinsep's reading of the Sanchi inscriptions, he was most liberal to the Buddhist community there. As, then, both the age and the neighbouring countries, as well as Malwa itself, were remarkable for the exertions making for the spread of the Buddhist religion in the fourth century A. D., the presumption (without any strained construction) is that the Caves were excavated about that period, which their own peculiarities strengthen. The only other prince of known extensive power, favourable to Buddhism, was Siladitya, in the seventh century; and in the impulse and transient revival which his energy and conquest gave to Buddhism, the Caves

might suppositively be placed in his reign, but they would most probably have been corrupted both in worship, and by *Brahminical infusion of style and ornaments.*

On the contrary, there is, first, no image-worship anywhere at Bágh, and though, as early as the third century B. C., "an image of Buddha was produced by a Thero, gifted with thirty attributes of bounty and eighty charms of perfection, surrounded by the halo of glory and surmounted by the lambent flame of sanctity,"* image-worship is acknowledged by all authorities to be a corruption of later date, and, Dr. Stevenson asserts, did not occur in Keneri until the commencement of the *fifth century* A. D. At Bágh the worship is of the primitive character, enforced originally by Buddhists, viz. that of the Daghob. An approach to the same, it is true, occurs at Nassick, in Cave No. 6 of Dr. Wilson's Antiquities of Western India, and No. 1 of Dr. Stevenson's; also at Junir and the newly-discovered Caves of Kuda and Wai, but it is incidental merely in these; whereas at Bágh it is the sole object in every Vihar and under all circumstances, the Daghob being not in alto-relievo *on the wall,* but in a chamber unconnected with a figure of Buddh in any way; and the same (as I have elsewhere stated) is found at Dumnar and Koolvee.

In Caves, especially Vihars, and also in Chaityas of recent origin, there is, in contradistinction to this, generally a figure of Buddh carved in front, and on the Daghob or on the vestibule; but at Bágh there is nowhere a figure of Buddh that is not subordinate to the Daghob, and they are usually in the antechamber or pillars facing it. In the first Cave the figures on the screen of the sanctuary, with outstretched right palm and the robe held up in his left hand, is, to my idea, a Buddhisutwa, and not the supreme Buddh. They occur at Sanchi in the same relative position, and have the same attendants; also at Keneri and Nassick. The Dwarpals at Bágh, on each side of the doorway, have also their exact counterparts, in two figures in advance of the Stambha of the north gateway at Sanchi, which must be accepted as emblematic of all that is correct in Buddhism. In the third Cave at Bágh the figures of Buddh are painted seated and squatted on the pillars *opposite* the Daghob, and the same in the garden scene; and I believe this to be the true and earliest attitude of Sákya Muni.

2. The strong *historical* similitude in the subject of the paintings on the conjoint Vihar and Convocation Hall to those at Sanchi, the drinking vessel, belt, ablution robe, and figures of Buddh and the

* Turnour's Mahavanso.

amb tree at the close of the procession, with elephants watching, are highly characteristic of the nature and intent of the painting, and seem a realisation of the truth of the description given in the Mahavanso, chap. xviii., of the consecration or erection of a Daghob, which appears to have been closely followed. The peculiarities are, however, a certain southern look about the features and dress of the people, resembling very much the inhabitants of the Carnatic in the present day, saving that the men are without head-dresses (perhaps in virtue of the special duty they are engaged in), and mostly beardless, but the Mahavanso accounts for this in giving it as a sign of ordination, every convert being pressed into initiation and to a withdrawal from the laity.

It may, and has been said, that the gradations of cave architecture are sufficiently distinct to admit of a degree of classification and a characterization of different eras, but it seems to me that this is more applicable to the cultivation or decoration of particular parts, as the enrichment of pillars and the more natural delineation of figures,—to execution, in fact, rather than to any variety of design or proportion.

With very few exceptions Buddhist Vihars, or monasteries, are all on the same plan, varied only on account of the means of the donor or the physical nature of the materials. They are always square, with an open central hall, in *hard* rock, or with pillars to support the roof in softer stone. Some, as at Adjunta and Bágh, have pillars corresponding to the number of cells, and separating the interspaces into an aisle which runs all round; some have vestibules and side chapels, and others not, but all indicate a general uniformity and consistency of design, the original of which it would be interesting to trace, but which I imagine was *structural*, from the squaring and crossing of the struts and roofs, the addition of windows, with beds behind the jambs of both these and the doors for *bolts* and *shutters*.

As in most points connected with Buddhistent ceremonies, the Mahavanso is here again the guide, and though it is nowhere positively stated that Indian Vihars were constructed edifices, yet, from the description of those erected in Ceylon B. C. 157 (which was converted to Buddhism by Indian missionaries), it may safely be assumed that their ideas were borrowed from the same source.

If I do not mistake, there is a structure to the east of the Sthupa at Sanchi overhanging the cliff, in which a Jain Digambara image is now placed, which was formerly a Vihar: a few cells even now exist to the south of the remains of the Garba Griha.

The general construction of ancient Vihars seems to have been compound, somewhat resembling No. 3 of the Bágh Caves, namely, a

Vihar with a Daghob in the centre. In the Mahavanso, chap. xxvi. the Daghob is stated to be "*encompassed* with a Vihar, and the Vihara with a banqueting hall of many stories," the priests being arranged in different floors,—

1. Pattujana, who had not attained sanctification.
2. Those who had acquired a knowledge of Tepataka.
3. Those who had acquired the several degrees of sanctity commencing with Sotopatti.
4. Arhats.

The Nepalese Buddhists (Mr. B. Hodson, page 93, says) adopted a similar plan. "In the *square* in the *midst* of every Vihar is placed a Chaitya, which (he adds) is exclusively dedicated to Adi Buddha the Celestial."

According to the Mahavanso also, the Vihars, which king Asoko, on his conversion, and as proof of his sincerity and exertion for his new faith, caused to be dedicated to each of the discourses of the Buddhist religion (exaggerated though they were to eighty-four thousand), were completed in three years, which would not have applied to the thousandth part of the number, had they been held applicable to *excavations* like the present Caves.

Upham uses the words Vihar and temple indiscriminately,—"The Uphawsica Vihar is termed (page 27) a *building constructed* in a particular part of the city." Again, "King Devanampyatissa constructed the following *temple,* the Kieripalo *Vihar.*" The terms must have had synonymous signification, which can only be reconciled with the notion that the structures were on the plan referred to, viz. a Vihar *built* enclosing or surrounding the temple. Rock cells would appear to have been distinct; by Upham they are termed "Meentalah," by Turnour, when in *mountains,* "Mahindagriha," and the commencement of sixty-eight is noted in chap. xvi.

The inference I feel inclined to draw is, that the Vihars of the earlier Buddhists were buildings similar in most respects to the Brahminical *Máths* of the present day, such as are to be seen at Ujayn and the principal sacred shrines. At Bágh, I conceive, the Daghob was placed *in* the Vihar, not so much from the absence of good material to work in, which abounds in the Vindhya Range close by, but from Chaitya temples being *unknown* while the worship was in its primitive state, viz. that of the Daghob.

Of the causes which led to the destruction of the Vihars, while Buddhism was flourishing, or which induced succeeding generations,

during the continuance of the same faith, to adopt the surer or less perishable method of excavations, there is little recorded or even suggestive of surmise.

In respect to architectural pretensions, the former left to the latter very few principles, unless massiveness and decoration can be so called; for though, from the existence of the base and architrave, their knowledge would seem to have been *derivative*, ponderousness is so much in excess in all their undertakings, and there is so much uniformity throughout, that art with them would appear never to have been put to the very simple experiment of how much breadth and massiveness could be sacrificed, consistent with security to obtain artistic result or effect.

The verification of this imitative trait of the Cave architecture I found at Nassick in caves of the fourth century A. D., the pillars of which were *exact*, though ruder, copies of the Sthamba at Sanchi five centuries prior to them, and Cave No. 3 had, as its doorway, a very rude attempt of the gateway. There were certain alterations, such as two architraves instead of three, the cornices supported by lions not females, but the Chakra, sun, &c. were *depicted* faithfully, also the peculiar balustrade or railing.

At Bágh, in the pillars of the Convocation Hall, a departure has been made from the routine, indicating that the excavators had found that broad architraves, short pillars, compressed cushion capitals, extensive bases, and close style, were not actually essential for the support of the roof; but it is questionable whether this was not a design supplied to them from other sources, Bactrian or Greek, for it is not carried further, or met with except in this solitary instance, and evidently was not approved of or appreciated.

The pillars of Indian architecture at this period (for columns they were not) are the most condemnatory evidence of their pretension to art. They have neither cornice nor frieze nor their components, as *Mutules triglyphs*, to form the entablature; in fact they did not, in this respect, know construction, or the effects of light and shade: but then, it must be admitted, their pillars were, at the most, *internal ornaments*, not external necessities, and sublimity was the last effect aimed at. All their efforts were expended on internal decoration for pillars of 14 feet instead of 40, where variety and ornamentation were more appropriate and pleasing.

The impending amount of their roofs and the nature of their work caused a certain preponderance of mass, which was to be expected from the nature of their materials, and it gave, of necessity, an expression

of mechanical power. The only *motive*, in fact, seemed to be that of support, which was, from lack of science, carried to excess, and the architect then strove, by ornament, to carry off and diminish the effect or defect. So the ponderous architraves were wrought into shapes of animals, the massive columns quartered and subdivided, reeded and fluted, the thickness of the walls broken by receding lintels and mouldings, in order to take off from their solidity and to give a semblance of lightness, which was almost an initiation of a maxim, propounded much later by M. Pugin, of "ornament consisting of the enrichment of the essential construction," except that the latter was here exceeded. Still their uniformity and rectangularity evidence *some* rule of procedure, and some principle; but I question very much if it was *not indigenous*; it certainly was not derived from any school or system *then* or *since* known to the world, the only nation that could have furnished any ideas to them being the Greeks, whose style they have not attempted, and whose period, like that of the Egyptians, was some centuries previous.

The cave architects were, however, in a measure compelled to study light, and by facing their excavations to the north they obtained sufficient without intensity of heat, or great brightness, for the sun in this latitude is only a few weeks to the north. In respect to apertures, they do not seem to have borne any proportion to the voids. In a space of 80 or 90 feet they had usually five openings; either one central door and four smaller ones, or three doors and two windows. The two lateral doors lit the side aisles and entrances to the cells, the next afforded light to two intercolumnations and to two cells in the rear, while the centre door (always high and lofty) threw the full force of the light on the vestibule and Daghob and centre of the hall, which was left clear for this purpose. That it was sufficiently forcible is proved by their painting, not only the rear walls and pillars, elaborately, but by their having drawings of Buddh on the faces of the pillars *furthest from the light* and fronting the Daghob, which must have been rendered visible.

It would have been gratifying to have identified in the Bágh monasteries some known establishment of the Buddhist, but the only one ascribed to Avanti in any work that I know of is the Dhakkinigiri Vihar at Ujayn mentioned in the Mahavanso. This was in existence B. C. 157, for forty thousand (query, forty) from it attended the opening of the great temple at Anaradhapura in Ceylon, with the Thero Dhámarukhito. Ujayn is here meant in its broad signification of "Avanti," as applied to the district or Soubah, not the city, which (as will be seen) was at least one hundred miles from the monastery of Dhakkinigiri.

The Mahavanso says that Mahindo (King Asoka's son), before proceeding to Ceylon, departed from Patna for Dhakkinigiri, to administer the comforts of religion to his mother's relations, where he passed six months. Now Asoka, his father, in a journey to Ujayn formerly, had married the daughter of a Setth at Chaitya, which, as I surmised in some remarks on the Koolvee Caves, would probably be found to be the present Sthupa at Sanchi. However, a further passage occurs, that Mahindo, having reached Chaityagiri, the capital of his mother, was established on the superb Chaitya Vihar. Mahindo's mother's relations being thus said to be at Dhakkinigiri and her capital Chaityagiri, the identity of the two would seem established. Most probably the former was a name given to a Vihar in connection with the Sthupa or Chaitya.

On both occasions, the journeys were commenced from (Patna) Palibathra to Ujayn, between which places the Chaitya and Vihar must have been; and if the above surmise of their consonance is correct, it would effectually debar the Bágh Caves from association with the Dhakkinigiri Vihar, as they are 200 miles to the west of Sanchi, and by so much out of the direct route from Patna to Ujayn.

In so far as I know, there is no mention made of any Vihars in Avanti in any other work, and I could not, unfortunately, discover any inscriptions on the rock or writing on the walls.

The former is not likely to have been executed in such friable rock, and the latter has most probably been detached among the fallen slices of plaster with which the walls have been loaded, to make up for the inaccuracies of the chisel, but it is quite possible a further search may bring some to light.

The dates of the Caves, for the reasons I have given, I should therefore be disposed to place in the fifth century, in the reign of Chandra Gupta, or Vicramaditya the Second.

ART. XIII.—*On the Ultimate Structure of* Spongilla, *and Additional Notes on the Infusoria.* By H. J. CARTER, Esq., Assistant Surgeon H. C. S., Bombay.

Presented 9th April, 1857.

IN the "Postscript" to my notes on the organisation of Infusoria, dated 10th June last,* it is stated, that apertures exist in the investing membrane of *Spongilla*, and that the particles of carmine taken in through them pass into the substance of the sponge-cells. This was added chiefly to correct an assumption in the body of the paper, that *Spongilla* lived by endosmosis.† I also stated that I should recur to these facts more particularly hereafter; but since that, up to within the last month, I have not had an opportunity of again pursuing the subject. I have during this time, however, succeeded in ascertaining the ultimate structure of *Spongilla*, by following its development from the seed-like body, and this I will now relate.

Those who are acquainted with *Spongilla* are aware, that it is charged towards the base with a number of seed-like bodies of a globular shape, each of which consists of a coriaceous membrane enclosing a number of delicate transparent spherical cells, more or less filled with ovules and granular matter, while an encrustation of gelatinous matter, charged with small spicules peculiar to the species, surrounds the exterior of the coriaceous membrane. It has also been shown that at an early period of development the spherical, which we shall henceforth call "ovi-bearing" cells are polymorphic—identical, but for the ovules, with the ordinary sponge-cell,—and surrounded by a layer of peculiar cells equally polymorphic, which I have conjectured to be the chief agents engaged in constructing the capsule.‡ It is desirable also to remember that

* See Ann. and Mag. Nat. Hist. v. 18, p. 242. The "Postscript" does not appear after my "Notes" in this Journal, because they were printed before I discovered my error.

† This Number, p. 446.

‡ Ann. and Mag. vol. 18, Pl. vi. figs. 41, 42.

there are these two kinds of cells in the composition of the seed-like body, because we shall find by and bye that they appear in corresponding parts of the newly developed *Spongilla*. Lastly, the seed-like body presents a hole, which we shall call the "hilum."

Having thus briefly alluded to the constituent parts of the seed-like body, let us now pursue the development of *Spongilla* from it. This takes place in the following order, viz. 1*st*—The contents issue through the hilum under the form of a gelatinous mass, in which the ovi-bearing cells and their contents appear to be embedded *entire*. 2*nd*—The spicules begin to be developed, and with them is formed a delicate pellicle, which not only encloses the new *Spongilla*, but also the seed-like body; to this pellicle we shall give the name of "investing membrane"; this becomes separated by an interval (which we shall designate the "cavity" of the investing membrane) from the gelatinous mass containing the ovi-bearing cells, which we shall term the "parenchyma." 3*rd*—Apertures are developed in the investing membrane, and a system of afferent and efferent canals in the parenchyma; the afferent canals commencing in many large apertures and afterwards communicating with each other, and the efferent canals commencing in *ramusculi* which end in a single tubular vent. In this period also the spicular structure is formed and arranged. 4*th*—The ovi-bearing cells are developed into spherical ampullaceous sacs, communicating with the afferent canals; and the afferent and efferent currents are established. We will now follow this more in detail.

First Period.—Three or four days after the seed-like body (which has never been allowed to get dry)* has been placed in clear water, a white substance, like cotton, is seen to have issued from the lower part of it. This, when examined, is found to present a flat, transparent border, so abounding in (indolently contracting) vesicles of different sizes, that it looks like an areolar structure. I wish particularly to call attention to this point, because it resembles the vacuolar state of the protoplasm in the early development of the cell of the Characeæ and probably of vegetable structures generally. The margin of this border is more or less irregular and digitated, from the polymorphic substance of which it is composed; while further in may be seen the ovi-bearing

* For this purpose it is best to place a piece of *Spongilla*, charged with the seed-like bodies, in a basin of water, where it will soon get putrid; but this does not matter; the seed-like bodies still retain their vitality, and will throw out the young *Spongilla* much more quickly than if taken fresh from the living mass. Those which I have used for these experiments belong to *Spongilla alba*, M. J. C., which was taken from the tank a year since.

cells in the denser gelatinous matter, with their ovules already somewhat diminished in size. The spicules have also begun to appear.

SECOND PERIOD.—We may commence with the formation of the spicules, which is so rapid, that they come into view almost simultaneously with the issue of the substance of the seed-like body.

*Spicules.*—These appear to be formed in sponge-cells of a peculiar kind, one of which is confined to the parenchyma, viz. that which forms the large smooth spicule, and the other to the seed-like bodies and the investing membrane, viz. that which forms the small spiniferous spicule characteristic of the species. Of the former, I can state nothing, except that it appears to be filled with ovules like the ovi-bearing cell, while the latter is characterised by the absence of ovules, a uniform granular composition, and the presence of a nucleus.

At the earliest period that a spicule becomes visible it appears under a hair-like form of immeasurable thinness, and enclosed in a sponge-cell of a spindle-shape, which has assumed this figure to accommodate it. The nucleus of the cell is now seen in its centre, and the spicule about $\frac{1}{100}$th of an inch in length lying across it. After a few hours the spicule becomes much larger and longer, and the sponge-cell still more extended to retain it within its substance; it also presents a glairy ovate globule in its centre, through which its shaft passes, not in the line of the longitudinal axis but on one side of it, so that the globule looks as if it were appended to it. When, however, the spicule is arrested at this stage of its development and denuded of the sponge-substance, that part which in the sponge-cell appeared to be a glairy, refractive globule, is found to be merely an inflation of the outer wall of the spicule, for the shaft of the spicule, slightly diminished in size, may then plainly be seen to pass through it in the manner beforementioned, and to present the longitudinal canal in its inside. In this state neither undiluted nitric acid nor a saturated solution of caustic potash produces any change in it, so that it may fairly be assumed to be of the same composition as the rest of the spicule.

By degrees, as the spicule is enlarged, the inflation is also proportionally increased in size, and disappears only when the spicule is fully formed. The normal state of the inflation appears to be single and in the centre of the spicule, but it may be situated on any part of the shaft or present in variable plurality.

In my notes on the organisation of the Infusoria I have stated§ that the spicule grows from a hair-like extension projecting from either side of a glairy globule, which now is found to be nothing but an inflation,

§ P. 118, Annals and Mag., *loc. cit.*

probably filled with refractive fluid. However, as we see that the spicule grows by layers deposited on the original one, which, therefore, forms the longitudinal canal, and, when it is fully formed, that the inflation is no longer visible, at the same time that the inflated portion is continuous with the outermost layer of the spicule while the latter is growing, it does not seem improbable that the first layer does arise from the linear extension of a globule, and that every succeeding layer is formed in the same way; (hence as there will be more layers in the centre than at the circumference, the spicule assumes a pointed form at each extremity), the inflation subsiding with the extension of each layer, until the final one leaves no inflation at all, and the spicule assumes its ultimate form. The original form of the spicule, therefore, appears to determine its ultimate one, and the spiniferous character of this will therefore depend on the tendency in all the layers to more or less assume this figure, whatever it may be. Whether the spicule is developed throughout by the same sponge-cell, or whether, after it very much exceeds in area any of the sponge-cells, which is always the case with the large spicule, a plurality are engaged in its ultimate development, or whether it continues to grow in the intercellular substance until it has reached its largest size, I am ignorant; but I have ascertained, by a series of observations and measurements, that it does not grow after having become denuded of the sponge-substance.

Again, I am not certain that the inflation, though extremely common, is always concomitant, or even necessary in the formation of the spicule, for many present no trace of it in any stage of their development, from the time they are first visible to that in which they have attained their largest size.

Long before the spicules are formed, however, they are transported from place to place by the sponge-cells individually, and when too large for this, are twisted and turned and grouped together by the general mass to meet the requirements of the case, with as much instinct as that which characterises the arrangement of the bits of stick in an ant-hill; while they appear never to become finally fixed until the substance in which they may be imbedded has altogether lost its vitality.

*Investing Membrane.*—As the sponge-substance accumulates vertically, the flat transparent border seems to disappear by being raised with the pellicular covering of the *Spongilla* generally, until it presents a considerable angle of elevation at the circumference; while the parenchyma, either by contraction within, or by forcing outwards bundles of its large smooth spicules, here and there separates itself from the

pellicular covering, and thus both the investing membrane and its cavity are formed. The investing membrane now supported in its position by these bundles of spicules, and kept on the stretch by the small spiniferous spicules which are scattered through its substance, presents two objects well worthy of description, viz. the peculiar cell to which I have before alluded, and a number of apertures.

The cells of the investing membrane are characterised by their uniformly granular composition and colourless appearance. They are nucleated, possess the contracting vesicle singly or in plurality, and are spread over the membrane in such numbers, that it seems to be almost entirely composed of them; while they are of such extreme thinness, and drawn out into such long digitated forms, that they present a foliated arrangement not unlike a compressed layer of multifidous leaves, ever moving and changing their shapes. This is, as I have before stated, the same kind of cell as that which forms the cortical layer of the seed-like body at a very early period; and, as will be seen hereafter, is further characterised by not enclosing any carmine when the other cells become charged with it.

The apertures, on the other hand, are circular or elliptical holes in the investing membrane among (in?) these cells. They seldom exceed $\frac{1}{700}$th of an inch in diameter, have a clean thin margin, which in one part presents a slight tubercular enlargement, and are generally surrounded by some minute colourless granules; while they have the remarkable property of closing or dilating like the pupil of the eye, but generally with extreme tardiness instead of the velocity observed in the latter. The tubercle looks very much like the nucleus of a sponge-cell, and, when the aperture is contracted, the granules may be seen to be enclosed in a circumscribed form, which, together with the presence of one or more contracting vesicles, gives the whole very much the appearance of one of the sponge-cells peculiar to the investing membrane. Through the apertures the particles of food and other substances suspended in the surrounding water are admitted into the cavity of the investing membrane, preparatory to passing into the parenchyma, in the manner which will presently be mentioned.*

Independently of all these structures, together with an innumerable number of minute contracting vesicles, the investing membrane is so

* These are the apertures to which I alluded in the postscript mentioned. Mr. Bowerbank also discovered them about the same time in England, and mentioned the fact at the British Association (*Athenæum*, 30th August 1856). His paper in the Quart. Jl. Microscop. Science I have not yet seen.

transparent, that every part of its cavity can be seen as clearly as if there were no membrane at all.

PARENCHYMA.—This consists of a mass of gelatinous substance, in which are imbedded the smooth spicules and ovi-bearing cells, and through which pass the afferent and efferent canals.

*Ovi-bearing Cells.*—The ovi-bearing cells do not burst and allow their contents to become indiscriminately scattered through the gelatinous mass in which they are imbedded, but each becomes developed separately, and entire in the following way, viz. the ovules and granules of the ovi-bearing cell subside into a granular mass by the former losing their defined shape and passing into small mono-ciliated and un-ciliated sponge-cells; this mass then becomes spread over the interior surface of the ovi-bearing cell, leaving a cavity in the centre, into which the cilia of the mono-ciliated sponge-cells dip and keep up an undulating motion; meanwhile an aperture becomes developed in one part of the cell which communicates with the adjoining afferent canal, and thus the ovi-bearing cell passes into an ampullaceous, spherical sac. The cilia may be now seen undulating in the interior, and if the *Spongilla* is fed with carmine, this colouring matter will not only be observed to be entirely confined to the ampullaceous sacs, but when the *Spongilla* is torn to pieces and placed under a microscope, particles of the carmine will be found both in the interior of the mono-ciliated as well as in that of the un-ciliated sponge-cells; proving, that of such cells the ampullaceous sac is partly composed.

This sac then must be regarded as the animal of *Spongilla*, as much as the Polype cell is regarded as the animal of the *Polype*, and the whole mass of *Spongilla* as analogous to a Polypidom.

Sometimes an isolated ovi-bearing sponge-cell which has escaped from the general mass may be seen to have undergone the same development by itself in the watch-glass; but in this case there appears to be no aperture, for particles of carmine brought into contact with it indicate no currents about its exterior, while within the cilia may be undulating as actively and as evidently as if it were *in situ*. Another proof also of the absence of an aperture is, that under this condition the ampullaceous sac encloses the particles of carmine which are in contact with its exterior, after the manner of *Amœba*.

I have stated that the contents of the ovi-bearing cell during development become spread over its inner surface, but at the same time I think it questionable whether this cell becomes revivified, or whether it is not ultimately cast off after a new one has been formed.

In proportion as the ampullaceous sac experiences a want of nourish-

ment after it has been fully developed in the watch-glass, so it gets thin, and, becoming more translucent, not only allows its aperture to be better seen, but presents an indistinct meridional lineation, which, radiating from around the aperture, meets at the opposite pole of the sac, thus giving the former an appearance not unlike the pupil of the eye; but though at one time it is larger and at another smaller, and not unfrequently of an irregular circular form, yet its changes are so gradual, that I have seldom, except when carmine has been added and taken into this sac, been able to see any alteration in its size or form for an hour together. When the aperture is in focus, the opposite point of the sac is invisible.

*Afferent Canals.*—The afferent canals consist of a number of channels which open by large apertures into the parenchyma from the cavity of the investing membrane, and then, freely anastomosing, form an areolated cavernous structure, throughout which the particles which are admitted into the cavity of the investing membrane subsequently circulate, and are finally received into the ampullaceous sacs which open into them.

*Efferent Canals.*—The efferent canals, on the other hand, begin by radicles in the interstices of the cavernous structure, among the ampullaceous sponge-cells (with the cavities of which, however, they do not communicate nor with the efferent canals, as will be seen hereafter), and growing into large branches, at length terminate in a single tube. This tube extends beyond the periphery of the *Spongilla*, and ends in a mammiliform point, in the centre of which is a single contracted aperture.

Thus we have the structure and composition of the portion of *Spongilla* developed from the seed-like body. Let us now direct our attention to its functions, which are easily elicited by placing a little carmine in the water and watching the particles as they pass through its substance.

No sooner has the carmine reached the exterior of the investing membrane than its particles are rapidly drawn in through its apertures, not vortically but direct, and, traversing its cavity, or the interval which exists between the investing membrane and parenchyma, in different directions, are thence drawn in through the apertures of the latter, and finally into the ampullaceous sacs, where they remain a quarter of an hour or more, until they are thrown off and find their exit through the efferent system of canals.

During their course, we observe, that on arriving near the ampullaceous sacs, they are rapidly drawn aside and for the most part pass into their cavities; and, seeking for those favourably situated for such

observations, that is, at the circumference of the parenchyma, we not only see that this takes place at one point only, but also, frequently, that at this part of the sac there is the circular aperture mentioned, and that they pass in through this aperture; further, after a certain time, we observe, that the particles of carmine which have accumulated round the inner surface of the sac, are gradually thrown off from its circumference, and, falling into the efferent system of canals, are thus carried away and finally ejected.

It would have been satisfactory to have seen the particles pass in through the aperture* while the latter was uppermost or undermost, and in the focus of the microscope, but this I could never do, perhaps from the rapidity with which they are whirled into the interior; but when the aperture happens to be on one side of the sac, the particles may be seen to pass through it into the interior, and generally to adhere to the first part with which they come into contact, when they are instantly enclosed by the sponge-cell on which they impinge. Again the aperture would not appear to be the only part of the exterior of the ampullaceous sac which is in communication with the afferent canal, but a much larger portion is bathed by the afferent fluid, for particles of carmine may be seen to adhere to the external surface of this sac as well as to be carried into it; and the latter seems to be more the case as the sac becomes altered from want of nourishment, after having reached its maximum of development under the circumstances mentioned.

If now we clear the watch-glass of all superfluous carmine by dipping it in clean water, and again place it under the miscroscope, the facts to which I have before alluded will become perfectly evident, viz. that the colouring matter is wholly confined to the ampullaceous sacs, and that the sponge-cells of the investing membrane do not contain a single particle; while, by tearing the *Spongilla* to pieces, it will be found as much in the bodies of the mono-ciliated as in those of the un-ciliated sponge-cells. Thus the component parts of the ampullaceous sac are easily demonstrated. One point, however, remains to be proved, namely, that there is no direct communication between the afferent canals, or the ampullaceous sacs, and the efferent canals. This is easily effected by placing a little carmine in the water and observing the moment of its entry through the apertures of the investing membrane and its exit through the afferent tube, when the interval will be found to

* This aperture corresponds in every respect, except the presence of the tubercle, with the aperture of the investing membrane; but I never could entirely satisfy myself that the latter was not a contracting vesicle, until I saw the particles of carmine pass in through it.

vary; but being seldom less than a quarter of an hour, is quite sufficient to show that there is no direct communication between these cavities; while the mode of enclosing the particles by the small sponge-cells being known to be like that of the *Amœba*, and their having been seen to throw them off at the circumference of the ampullaceous sac, and be immediately carried away by a current passing through the canal into which they are thrown, is still further corroborative of the fact; but indeed it requires no corroboration, for when the sacs are only one layer deep it can be seen.

We have now to consider by what power the particles are drawn into the ampullaceous sacs, and how a constant current through the *Spongilla* is maintained—questions which we can only hope to answer by a study of the organs of *Spongilla* individually, and fortunately, as far as the first enquiry goes, this is much aided by the change which takes place in the new *Spongilla* a few days after it has been developed.

The same difficulty which exists in maintaining life in the Infusoria, viz. the want of proper nourishment, is experienced with respect to the young *Spongilla*, and hence sooner or later it becomes starved; but frequently just before this takes place, the whole community of sponge-cells, more or less, separate, dissolve partnership so to speak, leave their habitation, and issue forth into the watch-glass to seek independent existences respectively for themselves. At this time the ampullaceous sac may be seen entire, but reduced to an actinophorous form, and presenting a single nucleus, while in other instances the community of this sac have separated and its mono-ciliated and un-ciliated sponge-cells are also seen spread about the watch-glass; also groups of much smaller mono-ciliated cells like those called *Uvella* by Ehrenberg; and lastly the characteristic sponge-cell of the investing membrane.

The one, however, which interests us most here, is the mono-ciliated sponge-cell of the ampullaceous sac (that which I once supposed to be the *andro-spore*), and this may be seen attached by a pedicular elongation of its substance to the watch-glass on one side, and with its single cilium undulating on the other. We have it now, then, exactly in the position for ascertaining the direction of the currents of the latter, and these, when a little carmine is added, are found to be towards the body on either side of the cilium, by which the particles of carmine may be seen to be thrown almost point-blank on its surface, and at the same time caught up (by apparently adhering to it, or by a process thrown out by it as in *Actinophrys, Sol.*) and rapidly passed into the interior. Hence we may easily conceive the united effort of all the ciliated sponge-cells in the ampullaceous sac being sufficient to produce a

considerable current into its interior, and thus to catch the particles which are passing through the afferent canals.

The other question, viz. that of the afferent and efferent currents, is not so easily solved, but still the mono-ciliated sponge-cell supplies data for at least speculation on that point. I have already shown in my notes on the organisation of the infusoria that the vesicula or contracting vesicle is an excretory organ, and that it discharges itself from the surface in many Infusoria, especially in the naked Rhizopoda, to which the sponge-cell is most intimately allied; and it so happens, that not only do these mono-ciliated sponge-cells present the contracting vesicle in great activity, but also in variable plurality, so that with those of the other sponge-cells lining the cavity of the ampullaceous sac, a continual and rapid discharge of water must be kept up, which, when we remember the character of this organ to discharge itself from the surface, and find that when the ampullaceous sac leaves the parenchyma it becomes nothing more than a large sponge-cell, we have, I think, pretty good reason to infer that these organs discharge their watery contents into the efferent system of canals; and when we consider the powerful organ which the contracting vesicles of all the ampullaceous cells together must form for effecting this function, that it does not seem unreasonable, in connection with the following facts, to conclude that the currents, both afferent and efferent, of the sponge, may be produced in this way.

It might be supposed, from what has been stated respecting the course of the particles of carmine through *Spongilla*, that the afferent and efferent currents never cease as long as it is alive; but such is not the case under some circumstances, for although no difference is appreciable when only a small quantity of carmine has been taken in, yet when there is an abundance in the water and the ampullaceous sacs become apparently filled with it, not only do these sacs one after another seem to close their apertures and refuse admittance to any more, but the whole investing membrane becomes drawn towards the parenchyma, its apertures all become closed, and the tubular vent of the efferent system retracted, and its aperture also closed, so that there is a total cessation of all active motion in the *Spongilla*; and this may continue for more than an hour, when the vent is seen to project itself as gradually as it became contracted, the investing membrane to resume its original position, and the apertures in both to open and admit and emit their currents respectively as before; but this time, the latter brings away the refuse of the carmine which has been and is still being thrown off into the efferent canals. In fact the *Spongilla* having been fed to satiety, appears

thus to shut itself up for a time for the purpose of digestion, and then open to throw off the refuse.

Again, it sometimes happens that one of the large branches of the efferent system bursts and gives rise to an efferent current before the tubular vent resumes its original dimensions and opens its aperture, by which two efferent currents are subsequently established, for the abnormal one does not close when the normal one becomes opened. Hence we have a further indication of pressure on the contents of this system, which will hardly derive explanation from anything but a force exerted by the contracting vesicles in the way mentioned; the conditions of the fluid in the afferent and efferent canals hardly holding out a sufficient difference in composition or density to account for this by endosmosis.

Thus we find *Spongilla* (for I have ascertained that the same structure exists in the large masses as in the small ones) composed of a number of stomachal sacs imbedded in a gelatinous substance permeated with specules for its support, and an apparatus for bringing to them food, as well as one for conveying away the refuse, while the nutriment which is abstracted by the process of digestion common to Rhizopodous cells, (*ex. gr. Amœba*), no doubt passes through the intercellular gelatinous substance into the general development of the mass; and if right in comparing the ampullaceous sacs to the stomachal cavities of the simplest Polypes, are we not further justified in drawing a resemblance also between the ciliated sponge-cells and those which line the stomach of *Cordylophora*,* of *Otostoma*,† and many of Ehrenberg's Allotreta; together with those in the stomach of the *Rotatoria* and *Planaria*,‡ which are evidently biliary organs, also having cilia floating in the cavity which receives the food.

Lastly, it is perfectly evident that each mono-ciliated sponge-cell possesses a large granule, which is of a greenish colour, and that the assemblage of these cells in the interior of the ampullaceous sac produces the assemblage of granules which are seen in it; also that these granules, when the ampullaceous sac becomes individualised and assumes an actinophorous form, represent "the granules" which I have described as a part of the internal contents of the Rhizopoda. May we not infer from this that these indicate the presence of similar cells in the interior of *Amœba*, &c.? If this should be the case, and that they are homologous with the liver-cells of the *Planaria*, then I shall

* See Prof. Allman in Phil. Trans. 1853, p. 370.

† Ann. and Mag. Nat. Hist. v. 17, p. 117.

‡ *Idem*, v. 8, Pl. vii. fig. 92.

have been right in my original conjecture that the "granules" are the homologues of the "spherical cells."*

It is proper to notice here, also, the affinities which *Spongilla* has to the vegetable kingdom. I have already alluded to the resemblance between it and the cell of the Characeæ at an early period, when both are filled with vacuoles; nor is the plurality of the contracting vesicle in the Rhizopoda generally, when matured, a less striking instance of the transition of the vesicula or contracting vesicle in the more animal infusoria into the passive vacuoles of the vegetable protoplasm. The nucleus of the Rhizopoda is typical of that which exists in the vegetable cell. Similar "granules" are also seen in motion at the extremity of the root-cell of *Chara* in the "fixed protoplasm"; and at present no difference can be shown between the molecular protoplasm in each. While as regards the production of starch, that is so common in every specimen of *Spongilla* that is met with, more particularly at the end of the season, that its presence is no novelty whatever. The mode of taking nourishment is different; but I have already stated that when the protoplasm leaves the cell of *Spirogyra*,† and even before its exit, it encloses nutrient matter after the manner of *Amœba*. While for the last year, some plants of *Chara*, which I reared from the nucules and have grown in a glass jar, have only been kept vigorous by dead grasshoppers, which every now and then, when the *Chara* begins to grow lighter in colour and meagre in appearance, have, by being thrown into the water, restored it to its former condition.‡ So that the same elements, under different circumstances, are thus made subservient to the same purposes. Hence the sponge-cell appears to be but a naked condition of the vegetable cell, and thus to become the first, or among the first, of animal organisms.

I would here also recur to the forms which the substance of *Spongilla* assumes when, under threatening of starvation, it leaves its habitation; not more to particularise these forms than to show how closely they resemble those of the protoplasm of *Spirogyra*, when, under simi-

* Ann. and Mag. Nat. Hist. v. 18, p. 125.

† See abstract of paper on the "Transformation of the vegetable protoplasm into *Actinophrys*," further on.

‡ In this instance I have noticed that the moment the plants become robust they cease to bear fruit, while when they become impoverished they throw forth nucules. The physiology of which appears to be evident, viz. so long as there is plenty of nourishment to build up more structure for ultimately making more propagative germs, this alone occupies the instinct of the plant; but the moment the nourishment ceases, the instinctive fear of failing in the propagative department causes the plant to turn its attention to preserve itself by forming seeds.

lar circumstances, it also leaves its natural habitation or cell-wall and seeks for food elsewhere. The smallest is that which resembles *Uvella*, Ehr. This consists of a number of minute mono-ciliated flask-shaped cells, which adhere by their pointed extremities respectively to a common centre point, whence the whole assumes a globular form. They are about $\frac{1}{3}\frac{1}{3}\frac{1}{3}$rd of an inch in diameter, polymorphic, and present the granule and contracting vesicles like the mono-ciliated sponge-cell of the ampullaceous sac; also enclose particles of food, and, on separating from each other, attach themselves by a prolongation of the body to the watch-glass, so that they are but a miniature type of the ciliated sponge-cell. The latter again, which I have already described, loses its cilium a day or two after it has come out into the watch-glass, and assumes an actinophorous form, becoming at last encapsuled. Previous, however, to losing the cilium, it progresses with the latter in front, and not behind, as when it is set free by tearing up a piece of *Spongilla*. While the ampullaceous sac, when remaining entire, also assumes an actinophorous form, loses all appearance of cilia internally, and encloses food after the manner of *Amœba*. All of which figures are so like those assumed by the protoplasm of *Spirogyra* when it breaks up and undergoes the changes to which I have alluded, that no doubt can be entertained of both organisms being Rhizopoda at this period.

Of the sense of feeling in *Spongilla* I have had no manifestations beyond the instinctive acts to which I have alluded; and that wonderful power of opening an aperture through itself, which the sponge-cell of the investing membrane apparently possesses; but in *Amœba Princeps*, which is a closely allied organism, I once saw the surface contract and become puckered several terms successively, on being pinched by a rotatory animalcule (*Diglena*), an experiment which this animalcule performed for me so satisfactorily, that I have no longer any doubt about the matter.

The "swarm-spore" described by M. N. Lieberkuhn,* which appears to me to be a ciliated form of the seed-like body and the same as the "gemmule" described by Dr. Grant, I have not yet been able to see; nor have I been able to see his "spermatozoa-like bodies," unless the *Uvella*-form just mentioned be them.

The formation of the seed-like body, however, now that we know the structure of the ampullaceous sacs, seems very intelligible; for we have only to conceive an enlargement of the small sponge-cells lining its interior, with the addition of ovules to them respectively, and the

* Ann. and Mag. of Nat. Hist. v. 17, page 407, 1856.

spicule-bearing sponge-cells of the cortical substance supplying the spicular crust to the exterior, to have a globular capsule thus composed, with a hilum precisely like the seed-like body; a conjecture which seems to derive support from the fact, that in some instances when the *Spongilla* is beginning to experience the want of nourishment, these sacs, small as they are, assume a defined, rigid, spherical form, from their pellicula becoming hardened and encrusted with extremely minute spicules.

## *Additional Notes on Fresh-water Infusoria in the Island of Bombay.*

As the printing of this Number of the Society's Journal is not yet closed, and I have observed several parts in my "Notes"* which require correction, alteration, and further explanation respectively, I take this opportunity of communicating the observations necessary for this purpose, and at the same time of supplying additional matter, which will render them more complete.

*Vesicula.*—At p. 443 it is stated that the existence of the vesicula "in *Astasia*, *Anisonema* (Duj.), and *Euglena* can only be determined by inference." Since then I have seen the hyaline vesicle, supposed to be the vesicula, empty itself in all three of these organisms, but more particularly in *Euglena viridis*, wherein a description of the process, which is peculiar, will serve for all the rest. It has been already stated, that in *Anisonema* the vesicula seemed to alter in size and shape without completely contracting, which is more or less the case with all this class of animalcules, and appears to arise from the presence of a single sinus in connection with the vesicula, as will be seen by the following description of the mode in which this function is performed.

In *Euglena viridis* the single sinus, which is attached to the side of the vesicula, after having become filled, pours its contents into the latter; the vesicula thus distended, is now pressed upon by the gradual refilling of the sinus, and thus its contents also become evacuated. Hence we never witness that sudden contraction of the vesicula which is so common in other infusoria, at the same time that it often appears double in *Astasia* and *Anisonema* (where it is more evident than in *Euglena* owing to the absence of colouring matter), from both sinus and vesicula being more or less distended together.

The only way in which this process can be well seen is, by getting specimens of *Euglena viridis* which are turning red, filled with ovules

* This Number p. 429.

and about to become capsuled or have been just burst from their capsules. These, which at this time are spherical, if placed in water under a light piece of glass and the water partly abstracted by bibulous paper, will, by the pressure of the glass, assume a compressed circular form, in the centre of which the vesicula and its sinus may be observed in full operation and be deliberately watched for some time, or until the infusorium dies.

Besides having been seen in *Polytoma uvella*, and *Chlamidomonas*, as before mentioned (*loc. cit.*) the vesicula has been seen and described by Mr. G. Busk in *Voloox Globator*,* and having myself also seen it in the *Thecamonadiens*, besides several species of *Euglenæ*, while it would appear that Cohn has observed it in the swarm-cells of *Confervæ*, its existence throughout this class of Infusoria seems thus to be established.

At p. 442 it is also stated respecting the vesicula—"in *Euglypha* I have not been able to recognise it"; but since then I have seen it frequently; it is situated in plurality just in front of the nucleus, as in *Euglypha pleurostoma*, H. J. C. (*nov. sp.*).

*Ovules.*—At p. 449 I have stated, respecting the "ovules" of Infusoria, that "they occur in *Euglypha alveolata*, Duj., congregated round the hyaline capsule of the nucleus, from forty to fifty in number," &c. I have also observed this in another species, viz. the one just mentioned, for which I propose the name *E. pleurostoma*; and the same kind of development described in the "larger variety" of *E. alveolata*, p. 452, as well. *E. pleurostoma* is very like Ehrenberg's *Difflugia Enchelys* and Dujardin's *Trinema acinus*, but not being identical with the figure given of the former, and though often presenting three radiated prolongations of the diaphane like the latter, but by no means constantly, it becomes necessary to give it a name. It is just possible hereafter that all three may be found the same, but even then it would be well to retain the term "*Euglypha*," because *E. pleurostoma* is essentially of this genus, the only differences between it and *E. alveolata* being the lateral position of the mouth and the circular figure of the scales in the former.

At p. 459, under the head of "Impregnation," it is stated that many of the ovules of *Spongilla*, when pressed out from the seed-like body, have a small granule or cell "in different degrees of connection with them, from simple approximation to almost undistinguishable incorporation"; the same is the case with the ovules of *Euglena viridis*.

At p. 459, under the head of "Development of the ovules," it is stated that the same process as that which takes place in the

* Quart. Journal Microscop. Sc. vol. i. p. 35.

development of the ovule of *Spongilla* "appears to take place in the ovules of *Euglena*," and this, to a certain extent, may be really the case; but as the ultimate forms of the two organisms are different, so there must be a point at which their developmental appearances begin to differ. This, in the ovule of *Euglena viridis*, consists in the evolution of a spiral structure, which, when fully formed, appears to spring out in opposite directions, and thus, with the diaphane, afford that means of vermicular progression which *Euglena* always presents when void of, or with only an injured or imperfect cilium.

I infer this from the following circumstances: first, that in a watch-glass, where a number of the ovules of *Euglena viridis* had been placed for observation, about a hundred small *Euglenæ virides*, closely corresponding in size with the largest ovules, made their appearance, elongating and contracting themselves incessantly for several days without moving far from the place in which they appeared to have been developed (on account of the imperfect state of their cilium), and, being without chlorophyll, presenting exactly the same appearances as fully developed individuals under similar circumstances. Secondly, from the ovules which remained on the sides of the basin from which those in the watch-glass were taken, presenting, after a while, a spiral line on both the flat sides of the compressed ovule, which apparently, from its resiliency, caused these sides to become prominent and obtusely conical; thus indicating an advance of development in these, as well as in most of those of the watch-glass, which was arrested, probably, from want of proper nourishment.

Now when we consider that the cells of *Euglenæ*, which we have called ovules, do not present any signs of an amyloid composition when treated with iodine, that the existence of the spiral line proves them not to be mere oil-globules, while the cell of *Euglena* ultimately developes a spiral structure in its substance, as I have particularly pointed out in *Crumenula texta*, Duj., and a number of minute *Euglenæ virides* made their appearance among a group of ovules of this organism, carefully set apart in a vessel for development; there can, I think, be very little doubt but that these cells, which are common in all the family, are in reality their ovules.

In the same page it is stated that "instances however do occur where the ovules gain a cilium within the cell," &c. I doubt now if these are developments of the *ovules*, but rather products of the other development which I have shown to take place in *Euglena*,* and consider

* Ann. and Mag. Nat. Hist. vol. xvii. pl. ix. figs. 11—14.

analogous, if not the same, as that described in the Characeæ and in *Spirogyra, (loc. cit)*.

It should be remembered that in obtaining the ovules of *Euglena viridis* for development, they should not be forced out of the organism but swept off the sides of the vessel an hour or two after the *Euglenæ*, together with some of the water in which they have been living, has been collected and set aside for settlement.

I have also met with another species of *Amœba* undergoing ovular development, viz. *A. verrucosa*, Ehr., precisely like that which I have already described; the *Amœba* perishing as the ovules are developed and ending in becoming a mere ovi-sac.

When first formed, the ovules, which are spherical, consist of a hyaline capsule enclosing a sphere of glairy, refractive fluid, like that of the ovules of *Spongilla* and *Euglenæ*; but as they begin to develope, this glairy matter becomes transformed into a granuliferous mucus which is spread over the inner surface of the capsule, and finally the granules present motion, whether of themselves or by aid of the mucus in which they are imbedded, I am ignorant, for thus far only have I seen the development; but I am inclined to think the next stage consists in the whole ovule becoming polymorphic like the ovule of *Spongilla*. This *Amœba* appears to me, for I have watched the development of a group for many months together, to be the adult of my *A. quadrilineata*, and therefore the latter not a new species. The formation and development of the ovules took place in April, and the organism appears to require at least nine months for maturity.

At p. 460 I have stated that I had observed "*Vorticellæ* developed singly from *Acineta*." This was from inference. I have since been able to follow the gemmules thrown off from the *Acineta*-form of *Vorticellæ* through their subsequent development, and in no case have seen them take on any other form than that of *Acineta*. The young gemmule at the moment of its exit is, as Stein has stated, exactly like the bud on *Vorticella*, but when pursued to its resting place I have always found it end in becoming an *Acineta*; so that this is not a true instance of alternation of generation. Others, viz. Drs. Lachman* and Cienkowski,† have arrived at the same facts; and these gentlemen also doubt the transformation of *Vorticella* into *Acineta*. Time will prove whether they or Professor Stein are right in this also; in the meanwhile I incline to side with the latter.

* Ann. and Mag. Nat. Hist. S. 19, p. 237, 1857.

† Quart. Jl. Microscop. Sc. No. xviii. p. 96, 1857.

In the same page it is also stated that the sudden contractile movement "of *Glenodinum* unites *Euglenæ* indirectly to *Vorticellæ*." I now find that this is not the case, as the "movement" is not one of the whole body or of the body at all, but of the cilium, which floating posteriorly, as that of *Anisonema sulcata* and *Heteromita ovata* (Duj.) &c., every now and then fixes itself by its sucker-like extremity and thus suddenly checks the progression of the organism. Whether the long cilium is also used for progression, or whether this is performed by the aid of the "minute vitratile cilia" noticed and figured by Dr. Allman* I am ignorant, but there does not appear to be a second large cilium for this purpose as in the animalcules abovementioned.

*Chara*.—At p. 462, in the additional matter which I have given respecting the development of monads from the cell-contents of the Characeæ, it is stated that they are derived from the nuclei which are found free in the protoplasm and in the rhizopodous or polimorphic-cells which exist in it; the nuclei becoming granular and the granules finally passing into monads; and this may still take place; but for the most part it now appears to me that it is the old protoplasm which becomes divided up into monads, after having first abstracted the starch from the dead chlorophyll and converted it into oil, the oil then appearing in a granular form enclosed within the monads; hence the origin of the "granules" mentioned at p. 463.

In the same page I have alluded to the "mulberry shape of the plasma" which we must now consider as the protoplasm. This derives explanation, I think, from the tendency of the protoplasm to assume an actinophorous form, and the radii at the time the pellicula covering them is about to become hardened, not being entirely retracted, but remaining in the pouch-like form which produces the mammillated or mulberry surface mentioned. That this does take place is frequently evidenced by the whole surface remaining actinophorous; and indeed it is only an instance of the way in which the peculiar forms of many structures are produced, viz. by the hardening of the pellicula upon the shape assumed by the protoplasm. It is therefore not difficult to conceive when the protoplasm and oil is subdivided into monads inside this mulberry-shaped capsule, how the "granules," which are in fact oil-globules surrounded by protoplasm, should get into these pouches.

As regards therefore impregnation or ovular development being connected with this process, we now see that both are out of the question; but still we have to account for the disappearance of the "nuclei."

* Quart. Jl. Microscop. Sc. vol. iii. p. 24, pl. iii. fig. 9, &c.

These, however, might also secrete a pellicula round themselves and undergo the same kind of division as the protoplasm, for they are endowed with a considerable degree of contractile power, though not so active as that of the protoplasm. Certain it is that cells containing no nucleus, as well as a cell containing one or more, will each produce a litter of monads.

I have made these observations first, but they will be better understood after persuing the following abstract of a paper entitled "Transformation of the Vegetable Protoplasm into *Actinophrys*," which was published in the "Minutes" of the monthly meeting of the Society held on the 19th Nov. last:

*Abstract.*

"The author stated, that when he first entered upon the study of the Infusoria and fresh-water Algæ, he had no idea of any union existing between the two, further than that of a gradual approximation of form and organization; and that he was opposed to any sudden leaps from the animal into the vegetable kingdom, or *vice versâ*, might be seen by the facts which he had brought forward, in attempting to account for the transformation that takes place in the Characeæ when the contents of their cells undergo the changes which he had described on a previous occasion (see Ann. and Mag. of Nat. Hist. vol. xvii. p. 101, February 1856). But latterly his opinions had altered, and he was now compelled to view these transformations as a direct passage of the protoplasm into monads.

"The process which ends in this development, had been called by Naegeli "abnormal cell formation," and Naegeli thought that in some instances germs were thus produced which propagated the plant. Nor could Pringsheim come to any other conclusion than that they were reproductive in *Spirogyra*, where he had more particularly observed them; while the philosophic Alexander Braun, after recapitulating all that had been made known on the subject in his "Rejuvenescence in Nature," adds, "the future will certainly unfold many interesting phenomena in this hitherto little worked field."

"Before detailing his observations on this development in *Spirogyra* which had led to the view abovementioned, the author had thought proper to premise a short account of analogous transformations in *Vorticella* and *Euglena*. In confirming most of what Stein had stated respecting the passage of *Vorticella* into *Acineta*, he observed, that he had never seen the young of the latter assume any other form than that of *Acineta*, but he had witnessed *Amœbæ* in the act of throwing

off living *Vorticellæ*. The passage of the contents of *Euglena* (which organism was much more allied to the vegetable than the animal kingdom) into rhizopods, was a common occurrence, and so nearly resembling that which takes place in *Spirogyra*, that it formed a good transitional link, perhaps, between the passage of *Vorticella* on the Infusorial, and the contents of the cell of *Spirogyra*, on the Algal side, into rhizopodus animalcules.

"It was in the cell of *Spirogyra crassa* (Kg.), (the largest perhaps of the genus) however, that Mr. Carter had latterly been watching these transformations, and it was to these more particularly that he wished to direct attention. The process was simply this :—

"Under certain circumstances the cell of *Spirogyra* apparently dies, the chlorophyll becomes yellow, and the protoplasm leaving its natural position divides up into portions of different sizes, each of which encloses more or less of the chlorophyll ; these portions travel about the cell under a rhizopodous form, the chlorophyll within them turns brown, the portions of protoplasm then become actinophorous, then more radiated, and finally assume the figure of *Actinophrys*. The radii are now withdrawn, while the pellicula in which they were encased is retracted or hardened into setæ with the rest of the pellicula, which now becomes a lifeless transparent cyst ; another more delicate cyst is secreted within this, and the remains of the protoplasm within all having separated itself from the chlorophyll, divides up into a group of monociliated monads, which sooner or later find their way through the cysts into the cell of the *Spirogyra ;* while the latter by this time having passed far into dissolution (not putrefactive) they thus easily escape into the water. Putrefactive decomposition at the commencement destroys this process altogether.

"At first it did not appear plain why the portions of protoplasm enclosed the chlorophyll, but afterwards it was found that this was for the purpose of abstracting the starch which accompanies the latter, since in some cases where the grains of starch were numerous the chlorophyll was not included.

"This was the process when the cells of *Spirogyra* were not pregnant with starch, as they are just before conjugating. When these changes took place at this period they were somewhat different, insomuch as the whole of the contents of the two conjugating cells become united into one mass, and having assumed a globular form, remain in this state until the chlorophyll has become more or less brown. After this the protoplasm re-appears at the circumference of the mass in two forms, viz. in portions which leave the mass altogether after the manner of

rhizopods, and in the form of tubular extensions which maintain their connection with the mass throughout. In both instances the protoplasm is without chlorophyll, but charged with the oil-globules, and both forms make their way to the confines of the *Spirogyra* cell, which they ultimately pierce, develope their contents, and discharge them in the following manner :—

"On reaching the cell-wall, each form puts forth a minute papillary eminence, which, having passed through the wall, expands into a large sac or bursts at its apex. Following the isolated form first, this then gradually drags four-fifths or more of its bulk through this opening, sometimes so much as only to leave a little papillary eminence in it, which then makes the portion of protoplasm look as if it were entering instead of escaping from the *Spirogyra* cell; the internal contents of this protoplasm then become more defined and granular, the granules assume a spherical form respectively, they evince a power of locomotion, and the originally flexible pellicule having become a stiffened cyst, with a more delicate one within (as in the process already detailed) assumes a slightly conical form, which giving way by a circular aperture at the apex, allows the granules to pass into the water, when they are seen to be monociliated monads; each consisting, apparently, of a film of protoplasm expanded over an oil-globule, and bearing a single cilium. The contents of the tubular form, on the other hand, undergo the same changes, but the tube becomes dilated into a pyriform shape within the *Spirogyra* cell, and when the monads are ready to lead an independent existence, the end of the papillary eminence which has been projected some little distance beyond the cell-wall into the water gives way, and thus they also escape.

"In another form of this tubular extension, the inner delicate cyst expands into a flask-like or globular shape, beyond the papillary eminence, outside the cell-wall, and retains the protoplasmic contents here, until they are ultimately developed into monads. These, which are much larger than the monads developed by the other processes, on issuing, move about rapidly for some time by the aid of a strong cilium carried in front like that of *Astasia*, and then become stationary, the vesicula or "contracting vesicle" which does not appear before they leave the cyst, now becomes very active, the cilium is gradually diminished in size and altogether disappears, and the monad passes into a rhizopodous, reptant state, which afterwards becomes actinophorous, and finally assumes a form undistinguishable from that of *Actinophrys Sol.*

"Up to this point the author had been able to follow this transformation, and although he had not actually seen the actinophorous form

enclose particles of food, yet he deemed the form itself sufficiently significant to guarantee this induction, since he had never witnessed a rhizopod of the kind without attacking everything living and dead that it could overcome and turn into nourishment; besides, such a form could obtain sustenance in no other way. If this was not satisfactory, it was not difficult to conceive that what the portions of protoplasm in an actinophorous form would do within, they would do outside the cell of *Spirogyra*, and it had been shown in the first process detailed, that inside the cell they enclosed chlorophyll and finally ejected the refuse in the manner of *Amœba*. Lastly, the monads which are developed by a similar process in the Characeæ, are frequently seen to issue from the cysts with portions of the brown chlorophyll in their interior, which, as they are not only monociliated but polymorphic from the commencement, they may be assumed to have enclosed after they had become developed from the purified protoplasm.

"The fact of portions of the protoplasm enclosing the chlorophyll for the starch it might contain, had been seen by the author most satisfactorily, in some spores of *Spirogyra*, which were in the anomalous state of being pregnant with grains of starch *without* chlorophyll, while their contents were undergoing the transformations above described. Here there was no colouring matter to impede the view, and the author had repeatedly seen the disappearance of the starch grains directly followed by the appearance of oil-globules; the dividing up of the protoplasm into portions each containing oil-globules, and a gradual lessening in quantity of the oil, indicative of its having become assimilated; while the transparency of the spore generally, enabled the observer to see that the whole of these transformations were effected not by any foreign organism, but by the protoplasm alone.

"It was true that the transformation of the protoplasm of the cell of *Spirogyra* and its movements above detailed, were unlike the phenomena of vegetable life, but the formation of the spore itself in the normal way, and the movements of the protoplasm of the conjugating cells just preceding it, merely required to be studied to bring about the conviction, that one was but a modification of the other.

"In the normal way, the protoplasm of both conjugating cells after having become pregnant with starch (for nutriment during their uterine life as it might be termed) combined, two cysts formed around this mass, the starch passed into oil, and finally the filament was reproduced without the presence of either,—living as before on endosmosis. In the abnormal way, the chlorophyll died, two cysts were formed round the portions of protoplasm respectively, the starch passed into oil, the refuse

of the chlorophyll was thrown off from the enclosed protoplasm in the manner of a rhizopod, the protoplasm divided up into monads which came forth as animals, that is in the form of rhizopods endowed with the power of locomotion and polymorphism, and thus under a form which does not live by endosmosis, but by the enclosure of crude material from which the nutriment is abstracted by a digestive process, and the refuse finally discharged.

"Lastly, the author stated, that whenever a mass of filaments of *Spirogyra* underwent these transformations, the latter were invariably followed by a numerous development of *Actinophrys Sol* of all sizes, to the exclusion at first of almost all other animalcules, and coupling this with the undistinguishable form from *Actinophrys Sol* assumed by the monads developed by these transformations, he saw no other more reasonable conclusion to come to, than that they were one and the same, and therefore that one source at least of *Actinophrys Sol* was the protoplasm of *Spirogyra*.

"Mr. Carter added that these phenomena were easily witnessed, since it was merely requisite to place a mass of the filaments of *Spirogyra crassa* about to conjugate, in a basin of water, and then watch the changes abovementioned, which would be sure to occur in many of the conjugating filaments; but of course, to be understood, they required a practised eye, or to be pointed out by a person conversant with the subject."

## *Errata in Article V. of this Number.**

Page 430 line 30, for "*Amœba,*" read "*Amœba*" throughout.
„ 432 „ 41, „ "questioned," read "suggested."
„ 438 „ 37, „ "anal," read "oral."
„ 440 „ 5, „ "found," read "formed."
„ 443 „ 24, „ "*Colacium vesiculosum,* Ehr.," read "the young of *Cyclops quadricornis.*"
„ 447 „ 13, „ "*Amœba (diffluens mihi),*" read "*A. Gleichenii.*"
„ „ „ 32, „ "not," read "seldom."
„ 450 „ 2, „ "*Euglena deses,*"-read "*E. viridis*" throughout.

* For illustrations and additions to this Article, as well as to Art. X. on the "Development of the Root-cell and its Nucleus in Chara," see Annals and Magazine of Natural History, vol. xviii. p. 115 for August 1856, and vol. xix. p. 13 for January 1857, respectively.

Page 451 line 3, for "*Amœba diffluens*," read "*Amœba radiosa*."
" " " 35, " "$\frac{1}{1200}$ to $\frac{1}{1800}$," read "$\frac{1}{1800}$ to $\frac{1}{1200}$."
" " " 36, " "about the width of," read "somewhat less than."
" 453 " 30, " "*Amœba diffluens*," read "*A. Gleichenii*."
" 455 " 6, " "*Euglenæ*" read "*Euglenæ agiles*, H. J. C. (nov. sp. ?)"
" " " 10, " "*Euglenæ*," read "*Euglenæ virides*."
" 456 " 3, " "*Amœba diffluens*," read "*A. Gleichenii*."
" 457 " 8, " "succeeds," read "seems to succeed."
" " " 25, " "act," read "process of true."
" " " 36, " "do not form," read "do not all form."
" 460 " 21, " "*Amœba diffluens*," read "*A. Gleichenii*."
" 465 " 30, " "*N. flava*," read "*N. fulva*."

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ART. XIV.—*Extract from a Report on Attempts made to supply Aden with Water.* By Lieutenant H. St. C. WILKINS, Executive Engineer, Aden. Communicated by the Government.

Presented 9th April 1857.

WHEN Aden was first taken possession of by the English in 1839, the inhabitants procured water for domestic and other purposes from a few wells in the valley of Aden, that is, from the crater of the extinct volcano: no wells were then in existence outside the crater. Some tanks, half in ruins and filled with rubbish, were found on the sides of the mountains, judiciously placed, and finely plastered, but appearing to have been in disuse for a long period. In an Arabic work, entitled "A brief history of Yemen," it is stated that the wall outside, and the reservoirs within Aden, were built by the Arabs before the year of the Hejra 906 (A. D. 1490), and that the governor of the rich town of Aden (the passage round the Cape, discovered in 1498, diverted the Indian trade from the Red Sea) then dug wells for sweet-water, and was successful. It may therefore be inferred, that from the time when water was thus procured, the tanks and reservoirs were suffered to go into decay; and perhaps another inference may be drawn, that

water obtained in the reservoirs was not so good as the well-water, although nearly all the latter must have been brackish.

2. Regarding the origin and nature of the fresh-water springs in the valley of Aden, two theories have been put forward: one, that fresh-water from the main-land of Arabia percolates through substrata of sand under the sea, and thus reaches the peninsula of Aden; the other, that the springs are entirely supplied by the rain which falls on the peninsula, and from heavy dews.

3. The first theory was put forward in the early years of our occupation of Aden, and was adopted by the Special Committee appointed to determine upon a definite plan for the defence of the peninsula of Aden. They acknowledged the difficulty of the question, but, after due consideration of the various reasonings in support of each theory, they came to the conclusion that the theory of percolation of water from the main-land through a pervious bed under an impervious bed of rock or clay, was entitled to their belief, and for the following circumstances:—

The water in most of the wells in the valley of Aden was found at a level below that of the sea. The wells, within the memory of the oldest inhabitants, had never been known to be dry, excepting after an unusually heavy draught from them in the day, and then they filled in the night, and the water next morning was found to be at the ordinary height. Little or no rain fell on the peninsula, seldom exceeding two inches in the whole year, and what little did fall became discoloured and putrid in two or three days when collected in tanks, so as to be quite useless except for washing. The water in the wells seemed to be nearly independent of all local circumstances of wind, weather, or seasons. The many wells containing water too brackish for drinking purposes were those nearest the sea, and supposed to be under the influence of filtration of sea-water. At Shek Othman, on the sandy plain, seven miles distant from Aden, good well-water was procurable, the soil apparently being the same as at the isthmus at Aden. The Committee, on looking down from some of the rocky cliffs washed by the sea, especially at Ras Marshag, in Holkut Bay, and also near Ras-el-Erigh on the isthmus, had seen a bubbling effervescence rise to the surface of the sea from the bottom, appearing to be occasioned by a spring of fresh-water forcing its way up through the sea. The Committee wished to follow up the investigation of these sub-marine springs in order to develope their true character, but the iron tubing applied for did not arrive until they had left Aden. They considered it within the range of possibility that these springs might turn out to be perennial

and valuable springs of fresh-water, similar to the springs of fresh-water in the sea at three fathoms depth off the island of Bahren in the Persian Gulf, vessels procuring the fresh-water by sending a diver down with an empty mussuck, or by securing a hose to the fresh-water spring-head at the bottom of the sea; and it was said that better water was procured in this manner than could be obtained on the island itself. Considering the small quantity of rain which fell on the Aden peninsula, these sub-marine springs were supposed to be springs of water from the main-land.

4. The Committee then adopting the theory of percolation from the main-land, considered it highly desirable that the experiment of boring on the plain of the isthmus should be tried. The experiment was considered a simple one, and the Committee were pretty sanguine of meeting with the water which supplied the wells of the valley of Aden.

5. A spot about half-way between Jeb-el-Huddeed and Ras-el-Girref was chosen, and the boring operation commenced. The Committee were of course in hopes of meeting with an impermeable bed of rock or clay below the sand, and by boring through this impermeable bed they anticipated coming upon a permeable bed of sand again, and fresh-water; but the boring operation proved anything but simple, for, at a few feet below the surface of the plain, salt-water from the sea drained into the bore, and tubing had consequently to be used to exclude the salt-water, and this rendered the operation of boring extremely laborious and difficult. Colonel Grant thought the experiment should not be given up as a failure until upwards of 200 feet in depth had been attained, but Captain Kilner found he could not drive his 8-inch tubing more than 72 feet; he afterwards drove 5-inch tubing 98 feet, and an auger 147½ feet, but it was found impossible to keep the salt-water out of the pipes, and so, whether fresh-water had been met with or not was never determined, as only sand with pebbles was bored through: it may, however, be considered that this boring experiment was a failure.

6. Numerous experiments were made in various parts of the peninsula outside the crater by blasting and boring, in the hopes of meeting with springs of fresh-water, but all these attempts proved unsuccessful.

7. The Special Committee recommended that a bore or well should be sunk on Flint Island, to be carried to a depth below all probable access from sea-springs; but their recommendation was never carried out.

8. The various attempts that have been made for increasing the supply of water at Aden, and their results, are as follows :—

| Boring where tried. | To what depth carried. | Results and Remarks. |
|---|---|---|
| No. 1. At the head of the valley between Ras Morbut and Ras Tarshayn, Steamer-Point. | 68 feet. | This experiment was tried by Lieutenant Western, in 1839-40, and only salt-water met with. |
| No. 2. At the head of the valley between Ras Morbut and Ras Tarshayn, Steamer-Point. | .... | This second experiment had a similar result to the above. |
| No. 3. In Western Bay, close under Shumshan Mountain. | 98 feet. | This bore was carried down 98 feet by Lieutenant Western. Pure salt-water was met with at this depth. As the bottom of the bore was however between 70 and 80 feet above high-water mark, the unexpected result met with was rather difficult of solution. It was considered casual, but this meeting with salt-water at so high an elevation above the sea is a proof against the Committee's theory, and strongly in favour of the second theory, which will be hereafter alluded to. |
| No. 4. On the isthmus under Durul-el-Hosh. | 50 feet. | Lieutenant Western found very brackish useless water at 50 feet, so the boring was stopped. |
| No. 5. On the isthmus under Durul-el-Hosh. | 60 feet. | Lieutenant Curtis, Executive Engineer, conducted this bore, and found similar water to the above. The experiment was |

| Boring where tried. | To what depth carried. | Results and Remarks. |
|---|---|---|
| | | discontinued, the breaking of the tools preventing its being persevered in. A well was then sunk at this spot, 54 feet, in order to extricate the broken jumper. The men working at this well being required for more pressing work, it was discontinued. At the depth of 54 feet it was found quite practicable to keep the excavation free from water, by means of hand buckets. It was remarked that the water which oozed in on the southern or Aden side, was perceptibly sweeter than that from the isthmus side—another proof in favour of the second theory. |
| No. 6. In Western Bay, about half a mile lower down the valley, nearer the sea than No. 3. | 205 feet. | At 57 feet brackish water was found, which gradually became worse. From the depth of 162 feet below the surface, to 191 feet, clay was found, with here and there stones in it. This clay was perfectly sweet below 191 feet; the bore went through clay and gravel mixed, and eventually gravel alone, which was very similar though coarser than the gravel in which sweet-water is found in Aden. The breaking of the jumper, too close to the end to allow of its being extricated, compelled Lieutenant Curtis to discontinue this bore, but he considered it sufficiently indicative of success to authorise his suggestion to the Military Board that a well should be sunk on that spot. |
| No. 7. Behind the Prince of Wales' Hotel, Steamer-Point. | 38 feet. | At 25 feet, when the boring began, such extremely hard rock was met with, that only two inches could be got through in three days; the well was then excavated 12 feet by blasting, when the work was discontinued. |

| Boring where tried. | To what depth carried. | Results and Remarks. |
|---|---|---|
| No. 8. Boring on the plain at the isthmus. | 147½ feet. | Captain Kilner drove 8-inch pipe 72 feet, and 5-inch tubing 98 feet; he also drove an auger 147½ feet. It was found impossible to keep the salt-water out of the tubing. The driving of the tubing, and the boring, was an extremely difficult operation, the tubing was fractured and other accidents occurred. |

9. After these experiments, boring for water was discontinued; it was not considered worth resorting to any further, as in case of accident occurring to the boring implements, as mentioned above in cases 5 and 6, the experiment had to be commenced again *de novo;* and even if the experiments were successful, it would be necessary to dig a well afterwards, and build up with permanent masonry—an expense that exceeds but little that of boring when hard rock is met with, and in some instances the expense and difficulty of boring exceed even that of digging a well, as when a succession of iron-tubing is necessary beyond a certain depth to exclude sand or salt-springs.

10. The utility of boring then at Aden appeared to be limited to the discovery of the spot where permanent wells might be successful, by a somewhat speedier, and, in some instances where rock is not met with, a cheaper process than well-digging.

| Experiment. | Depth attained. | Results and Remarks. |
|---|---|---|
| No. 9. Well under Ras Meil, eastern extremity of the line of isthmus works. | 43 feet. | This well was carried to a depth of 43 feet, with a diameter of 15 feet. At first the water was stated to be particularly good. The Civil Surgeon wrote, saying, the water was certainly not salt-water—"It "contains sulphate of soda, sulphate of "potass, a small quantity of muriate of "soda, with a little uncombined carbonic "acid. I think it comes from the same "source as the water in the wells inside |

| Experiment. | Depth attained. | Results and Remarks. |
|---|---|---|
| | | "the town. The specimen of stone "which accompanied the water, and "through which it rises, is a fresh-water "formation."<br>However, Dr. Herbert Giraud, Professor of Chemistry in the Grant College, did not coincide exactly in opinion with the Civil Surgeon at Aden, for he wrote regarding the same water, a sample of which had been sent to him for analization—"Water for use generally con- "tains only one part of saline matter in "8,000 or 12,000 of water; any water "containing more than one part in 2,000 "is unfit for such purposes. The Ras "Meil well-water contains 29·5 parts "in 1,000 of water, making it identi- "cal with sea-water (sea-water contains "from 20 to 44 parts in 1,000). The "presence of the characteristic ele- "ment, bromine, completed the resem- "blance."<br>The Special Committee wrote concerning this well—"At first the water in this "well promised to be particularly good, "but now the sea-water has apparently "penetrated into it, so that its water "differs but little from that of the "sea." |
| No. 10. Under Ras Meil, a few yards from the well abovementioned. | .... | This well was commenced before the well last mentioned, a few yards lower down the ravine. The water found was stated to be very good, but the well being thought too near the sea, the well last referred to was commenced, and this one left with only a small hollow in it containing about 2 feet of water. This |

| Experiment. | Depth attained. | Results and Remarks. |
|---|---|---|
| | | same water is afterwards described as being very unpleasant to the taste, bitter, and sulphurous, but not very salt. The Special Committee wrote—"There evi- "dently appears to have been a small "quantity of fresh-water in this spot, "but the soil being of a loose descrip- "tion, as the depth of the well was in- "creased so the sea-water penetrated "into and destroyed it." |
| No. 11. Well dug in Western Bay near Little Pass. | 67 feet. | This well, 18 feet in diameter, was excavated to a depth of 67 feet, through soil capable of removal with a pickaxe; no blasting was used; but the sea-water penetrated into it to such an extent, that although three parties were employed for several days and nights without intermission, they were unable to reduce the quantity. |
| No. 12. Well behind Prince of Wales' Hotel. | 42 feet. | This well I suppose to have been excavated at the original bore (vide No. 7): it was excavated 12 feet in diameter to a depth of 42 feet; 30 feet was excavated with the pickaxe, the remaining 12 by blasting in very hard rock. |
| No. 13. Well near Ras Morbut Battery. | 50 feet. | This well (perhaps identical with the bore, vide No. 1) was excavated 12 feet in diameter to a depth of 50 feet, partly by pick and partly by blasting. It was discontinued at this depth. |
| No. 14. Well at the Hedjaff, Western Bay. | .... | A well was excavated at this place last year. It was hoped that water would be found available for the Irregular Horse, for washing and such purposes; but the |

| Experiment. | Depth attained. | Results and Remarks. |
|---|---|---|
| | | water was found to be identical with sea-water. |
| No. 15. Well in Western Bay under the cliff opposite the Biggarees' Hospital. | 65 feet. | This well was excavated by a private individual last year. Drinking water was found. The well yields about 20 gallons per diem. The water in this well is about 60 feet above the level of high-water mark. |
| No. 16. Well at the Hedjaff, high up the valley. | 44 feet. | This well is now being excavated by a private individual. It is 44 feet in depth, but as yet no water has been met with. |

11. These I believe comprise most, if not all, the experiments which have been made by boring and well-digging for increasing the supply of water at Aden. In the valley of Aden numerous old wells have been cleaned out and deepened, with more or less success. Some, carried down upwards of 200 feet, have disappointed the explorers; others have given tolerably sweet water; and some, water too brackish to be drinkable. No really sweet water has been discovered, neither has any inexhaustible supply of drinking water been found.

12. The well containing the best water in Aden is the Bir-ul-Dowlah, in the Kussaf valley. This well is 185½ feet in depth. It is an old well, and at the time of our occupation of Aden it was only 18 inches in diameter, and I believe it is the same depth now. It was not a straight well; and when, in 1844 or 1845, the well was increased to 18 feet in diameter, the drift-way of the old well was found to have turned out of the directly vertical line to avoid hard rock. How this well was originally sunk only 18 inches in diameter and tortuous, is a question difficult to solve. However, the water taken from the well being nearly if not quite sweet, it was enlarged to a diameter of 18 feet, and the Special Committee hoped to increase the supply from it sufficiently to furnish the whole of the troops with its water.

13. The supply, however, was never increased; it gives about 140 gallons per diem.

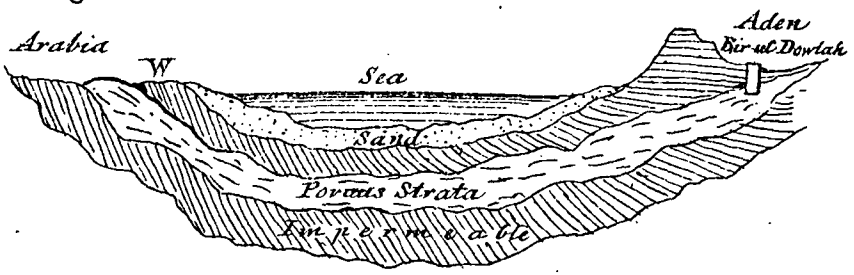
14. In the Hydross valley, in the Aden crater, are numbers of old wells, most of them filled with rubbish and débris. Were these excavated, water would undoubtedly be met with, brackish or otherwise of course can only be determined by experiment.

15. To turn now to the second theory regarding the nature and origin of the fresh-water springs at Aden—that these springs derive their supply "from rain which falls on the peninsula and from heavy dews."

16. The numerous experiments of boring and well-digging which have been made, prove something. They perhaps do not prove the truth of the second theory, because, volcanic action having so completely broken up the original formation of the rocks and substrata, well-digging and boring at Aden must be by a fortuitous chance successful, and the sites selected for the experiments detailed may have been ill-chosen or unlucky. Still, water outside the crater of Aden has been met with, but it has been salt or very brackish. How then are the wells in the valley of Aden supplied? how is the Bir-ul-Dowlah supplied? The bottom of this well, containing the sweetest water in the place, is 100 feet above high-water mark! By the first theory it is an Artesian well, by the second simply a land-spring.

17. If it be an Artesian well, sweet-water from the main-land of Arabia must percolate through a porous stratum. The rain-fall upon the surface of the porous stratum soaks through it, until it meets with a retentive substratum; the water then follows the lowest levels of the permeable stratum, but the sea intervenes, and therefore the porous stratum must have impermeable stratum above it, by which the salt-water is kept from mixing with the sweet.

18. Supposed formation to account for the Bir-ul-Dowlah well being Artesian:—




If the Bir-ul-Dowlah well, then, be Artesian, the water which sup-

plies the well comes from the main-land at W. The bottom of the well is 100 feet above the sea; of course then W must be 100 feet or more above the sea level, and we may suppose the flow of water to be regulated by the same laws below as above ground.

19. Now the peninsula of Aden is composed of unstratified basaltic rocks. Volcanic action has completely broken up its original formation. The Bir-ul-Dowlah well *may* be an Artesian well, but it is not probable.

20. If the Bir-ul-Dowlah be supplied from a land-spring, rain on the peninsula must be the origin of the supply. The surface of a district over which rain falls or flows, consisting of a loose permeable material lying upon a retentive substratum, water soaking through the above collects in any depression of the upholding bed. The Bir-ul-Dowlah well, then, has been excavated over a small depression of this description.

21. The wells in the crater of Aden are all situated in valleys which receive the drainage from the Shumsan range of mountains and an extensive plateau below.

22. There are some 31 wells of sweet-water in the Kussaf valley, the Bir-ul-Dowlah being one. Some give 3,000 or 4,000 gallons of sweet water per diem; others but a very small quantity. Some wells are 100 feet above the sea level, others far below it; these wells are very close to each other. Can they then be Artesian wells? must they not be supplied by land-springs?

23. In experiment No. 5 on the isthmus, the water which oozed into the excavation on the crater side was considerably sweeter than the water which oozed in on the isthmus or sea side.

24. Very little rain falls on the peninsula of Aden. The Special Committee stated that the quantity did not probably exceed two inches in the whole year.

25. The quantity has never been very accurately ascertained.

In 1834 the rain came down twice.
„ 1837 once.
„ 1839 once, very heavily, with a rush of water.
„ 1842 once; 5½ inches fell in 3 hours.
„ 1846 once; a very heavy storm.

26. From the above it would appear that heavy storms at Aden occur thrice annually.

| | | | Inches | Cents | |
|---|---|---|---|---|---|
| 27. | In | 1850 .. .. .. | 5 | 0 | of rain fell. |
| | „ | 1851 .. .. .. | 1 | 50 | „ |
| | „ | 1852 .. .. .. | 6 | 25 | „ |
| | „ | 1853 .. .. .. | 0 | 75 | „ |
| | „ | 1854 .. .. .. | 6 | 65 | „ |
| | „ | 1855 .. .. .. | 2 | 70 | „ |
| | „ | 1856 .. .. .. | 1 | 46 | „ |
| | | Total in 7 years .. .. | 24 | 31 | |
| | | Average fall in one year .. | 3 | 47 | |

Several showers are unrecorded in the above.

28. The valleys in which the wells of Aden are situated receive the drainage of the north-eastern side of the Shumsan range of hills, and also of a large elevated plateau between the Aden valley and the hills. During the heavy falls of rain which sometimes occur, water from the hills rushes down the narrow and precipitous valleys with great violence, much damage is done to the town, and a considerable quantity of water escapes into the sea. Where the water falls on or rushes over loose or permeable beds, it of course soaks through until it meets with a retentive substratum.

29. I will endeavour to deduce what this drainage is, and in doing so I will, for fear of exaggeration, take the lowest data consistent with accuracy.

30. I have shown that an average of seven years' rain gives a yearly fall of 3·47 inches, and several showers were unrecorded during the seven years; but I will not increase the quantity on that account.

31. In England the depth of dew in the year has been found to be 5 inches. Dews in Aden are occasionally very heavy. I shall perhaps be rather under the truth in taking the depth of dew in Aden at 3 inches.

32. The rain and dew together, therefore, give 6·47 (six inches forty-seven cents) of water yearly.

33. Two-thirds of the depth of rain and dew has generally been allowed for escape by evaporation; but from calculations made of the discharge from the Thames, and the area of land drained by that river, two-thirds has been found to be rather too large an allowance for evaporation. I will, however, take two-thirds of the depth of rain and dew for the loss on account of evaporation; 2·15 (two inches fifteen cents) will remain.

34. From the plan of Aden it will be seen that the valleys of the

wells receive the drainage of an area two and half miles long by one mile broad.

35. This area comprises 69,696,000 square feet; taking the depth of water as 2 inches, the total supply of water is 11,616,000 cubic feet: 1 cubic foot = 6·2321 gallons, 11,616,000 cubic = feet 72,392,073 gallons, omitting decimals.

36. The daily issue of water from the wells in the Aden valley is 15,000 gallons: 15,000 × 365 = 5,475,000 gallons, the yearly issue of water from the wells; that is, the largest supply of water that can be obtained from the existing wells.

37. 72,392,073 — 5,475,000 = 66,917,073 gallons, the surplus of rain and dew in the year over the issue from the wells.

38. As I have before stated, a great quantity of water during heavy falls of rain escapes into the sea; but it is nevertheless apparent that the quantity of rain which falls on the peninsula of Aden together with the dew, is a sufficient source of supply for all the wells which now exist in the valley of Aden.

39. The Bir-ul-Dowlah may be said to be the only well which gives really sweet water, all the other wells are more or less impregnated with salts. Some wells in the lower part of the valley may be impregnated by filtrations from the sea, but probably the brackish wells are so in consequence of the many salts contained in the rocks and earth of the peninsula, which are taken up by the water in its filtrations.

40. In experiment No. 3 it is stated that salt-water was met with 70 or 80 feet above high-water mark! The unexpected result could not be solved. It is probable that the water found was not sea-water at all, but fresh-water highly impregnated with the salts of the earth.

41. In experiment No. 9 the water found was not only salt but very nauseous and mephitic; and in experiment No. 15 a small quantity of sweet-water has been found some 60 feet above high-water mark.

42. Are the wells not then supplied by land-springs?

43. Several schemes for damming up the ravines in the valley of Aden have been proposed, but none have been carried out.

44. In 1848, Major General (then Lieutenant Colonel) Waddington submitted a plan and estimate for damming up the valley above the Banian well, but the Government of India refused to sanction the work proposed.

45. In the Tawelah valley, Lieutenant Playfair, Assistant Political Resident, has discovered a series of fantastically shaped tanks: these tanks have been probably neglected since A. D. 1498, and gradually filled with rubbish and débris from the hills. They were buried many

feet below ground. The discovery has led to stricter search, and the whole of the Tawelah valley to the town is covered with tanks. A number of tanks at the head of the valley have been cleared out by Lieutenant Playfair, who anticipates retaining in them the first heavy fall of rain, some three and half millions of gallons. When all the tanks he has found are cleared out, he estimates their capacity at twenty millions of gallons.

46. Will not Brigadier Coghlan and Lieutenant Playfair's attempts to increase the supply of water in Aden by clearing out these tanks prove successful? It is to be hoped so; but it has yet to be proved practically whether the water retained stagnant in these small tanks will keep pure and good for drinking. In any case the water will always prove most useful.

47. Probably the best plan for increasing the supply of water in Aden would be, by building dams across the ravines high up, similar to the plan referred to in para. 44. These dams would retain water and increase the filtration through the permeable and loose beds above the wells, and so increase the supply in the wells.

48. No amount of sweet-water has as yet been found outside the crater of Aden. Many attempts have been made in Western Bay. The wells when excavated high above water-mark have not rewarded the sinkers, and when the excavations have been made low down in the valley, sea-water has only been met with. Western Bay is probably about the least likely place in the peninsula in which the search for water would prove successful.

49. In some of the bays on the south-western side of the peninsula sweet-water might be found, if the site for the well be judiciously chosen as regards water-shed, area drained, and the probability of sea-water filtration avoided.

50. The Huswah scheme has, I believe, failed, and in my humble opinion the only method by which the supply of sweet-water at Aden could be *materially* increased would be by repairing the old aqueduct, from Shek Othman or Bir-Ahmed on the main-land. If, in former times, the aqueduct was found to be of value, surely at this period it would prove to be so also.

51. Few branches of natural history have given rise to so much discussion as the theory of springs. It is impossible for any one to say for certain that the Aden wells are Artesian or supplied by land-springs; but from the experiments and attempts to increase the supply which have been made at various times, and of which mention is made in this Report, I think a conclusion hardly doubtful may be arrived at, and

in conducting any future search on the peninsula of Aden for sweet-water, perhaps the investigations I have made, and the deductions which I have drawn, may not prove valueless.

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## Art. XV.—*Letter from* F. Broughton, Esq., Assistant Surgeon H. C. S., *to the* Rev. Dr. Wilson, Honorary President, *on Cave-Temples near Wagotun.*

Presented February 1857.

My dear Dr. Wilson,—In September last I passed a few days at a place called Wagotun (from Wagostan, a country of tigers), near Viziadroog, on the western coast of India; and bearing in mind our cave-temple inquiries, I was fortunate enough to discover same excavations not previously described, and an account of which may be interesting to you, as completing my former observations, and carrying them to the coast.

Wada Parell is two and a half kos from Wagotun and about seven miles from the sea. The approach is difficult, as the traveller has not the advantage of anything in the shape of a road, but must pass over one continued slippery and undulating surface of sheet rock. On arrival, however, this exertion will be amply repaid to any one appreciating beautiful scenery, or curious in antiquarian research. The village is situated at the mouth of a prettily wooded ravine, surrounded by palms and magnificent specimens of the Kajra (*Strychnos nuxvomica*). Crossing a stream you ascend the ravine, at the upper scarp of which this temple is found, together with one or two cells of the ordinary character so frequently seen in this country.

As may perhaps be surmised from the accompanying sketch, the outer verandah is artificial, having been recently added to the excavated frontage. The verandah is 14 feet wide, and constructed of laterite. Passing through you enter the rock-cut temple, 24 feet long by 28 feet wide. Three pillars are left on either side, and separate the hall from a side verandah 10 feet wide abutting upon the rock. The pillars are 12 feet high, carefully though not richly carved, and provided with base and capital. Walking forward in the centre, twelve

stairs conduct you into an inner temple, 15 feet by 12, and 6½ feet in height. This recess has a flat roof and contains a lingum.

Outside on either flank are two elephants, also cut out of the solid rock, each animal being provided with a block of stone upon which he rests his trunk, and each being surmounted by a deified mahaut.

In front of the temple are other figures with obscene details. These are not (as I at first suspected) recent additions, but form part of the original design. A few dipmals occupy the paved courtyard extending to the brink of the stream.

By ascending a painful series of steps on either side, the devotee passes up to the table-land above this temple, and, descending on the opposite, accomplishes the sacred circuit. Following the track of the circum-ambulator, I found that a deep trench had been cut round the entire temple from above and behind. This is evidently done to preserve the same from the action of the monsoon, as connecting channels are observed below. For this purpose also the roof and verandah have been covered with chunam. By this cutting, which is 3½ feet wide, this entire temple is rendered monolithic, the recesses for the elephants in front but slightly connecting it with the parent rock.

The oft-told tale of the excavation of this temple by Pandoorung, and its completion in a single night, was all the information I could obtain from the shabby-looking residentiary ecclesiastics with whom I conversed. It is, I think, of Hindoo origin, and may be perhaps remarkable from its size as a monolithic temple.

### *Excavations of Sagwa.*

About eight miles south of Wagotun, on the bank of the river, is a little fishing village, called Sagwa. Close to this village, and as usual situated in a most romantic, well wooded, and amply watered ravine, are the excavations of which I had received information. On approaching the scarp, two sadly ruinous temples and several cells were discovered pierced into the once solid rock. The largest temple was only 14 feet by 10, supported by four slightly ornamented pillars. The action of the monsoon, and the chemical action consequent thereupon, have broken up the face of this scarp, and the original nest of cells, the temples, and portions of a connecting stair-case now lie in a confused heap of ruin. From the remains of ancient pathways favourable to circum-ambulation, I conclude these also to be Hindoo. Incessant rain prevented my obtaining any sketch of this pretty spot. According to the traditions of the people our friend Pandoorung was also the author of this group, and marks of his hand are pointed out as evi-

dencing this fact and indelible in the hardest rock. It then seems probable that the experience he derived from the destruction of this series may have induced him to isolate and so preserve the temple at Wada Parell in the manner previously described.

*Cavern at Motad.*

I also visited a cavern at a place called Mootad, worth describing, although never, I am disposed to think, intended for any worthy purpose. Close to Wagotun a stream of some size and rapidity suddenly sinks among the rocks forming its bed, and emerges again deep down at the bottom of an adjoining ravine. By some disturbance of the rock, the stream, instead of passing over the edge and forming a cascade, found a natural channel and a nearer way of arriving at its destination. In the course of this natural channel there was an enormous cavern, 120 feet long, 40 wide, and 11 in height, all access to which was cut off by the stream above and below passing through it, and it could only have been discovered by some person entering from below in the dry season.

The discovery however took place, and stair-cases were cut down through the rock above into the cave, and a canal 18 feet deep by 3½ feet wide dug out below through the entire length of the cave, which seems natural, although small excavations on the upper sides appear artificial. By this canal the water passes through, leaving the cave dry and capacious even in the rains. The apertures above seem formed for concealment, and stones easily close the entrances of the stair-cases.

The object of such gigantic labour must have been very urgent and probably illegal. I am disposed to think it must have been a retreat for the piratical hordes who so long infested this coast. It is a convenient distance from Viziadroog, and in all probability its recesses frequently enabled the outlaw to bid defiance to pursuit.

The singularity of this retreat must be my excuse for troubling you with a subject so foreign to the immediate object of my communication.

Believe me, &c. &c.,

*Kolapore, 20th January* 1857. F. BROUGHTON.

## ART. XVI.—*On Contributions to the Geology of Central and Western India.* By H. J. CARTER, Esq.

May 1857.

*Central India.*—To no one is the Society more indebted for contributions to its museum from, and interesting notes on, "fossil sites" at and about the neighbourhood of Saugor in Central India, than Captain W. T. Nicolls, of the Madras Army. His last present, which was made on his leaving Saugor in bad health on the 8th April 1854, amounts to upwards of 500 specimens, consisting chiefly of portions of the limestone, argillaceous strata, and fossils from the intertrappean lacustrine deposits, silicified wood, trap, and sandstone at Saugor; of silicified wood, and bones of large mammals infiltrated with silica from Narrainpoor, about 17 miles SE. of Saugor; and of fossil-bones, shells and wood from the conglomerate of the valley of the Nerbudda at Burman Ghât and its neighbourhood, about 60 miles south of Saugor, all numbered, catalogued, and described with much useful and interesting detail. A great number of the specimens of wood, agate, and sandstone have been beautifully polished, and the whole forms a geological collection which, in point of bulk and value, exceeds any that has ever been made to the Society.

One of the most interesting of Captain Nicoll's written communications is his description of one of the sites at Saugor where fossil palm-trees are found, and this we shall give in his own words, only altered and abridged a little, to avoid references to the plan which accompanied it, but which the clearness of his description renders unnecessary to print.

*Memorandum to accompany a Section and Ground-Plan of a Fossil Palm-tree discovered at Saugor.* By Captain W. T. NICOLLS, Madras Army.

"There is a spot near Saugor traditionally known to a few people as a place where fossil palm-wood is to be found; it is, however, so little marked by the fossils on it, that I have known people walk over, with-

out discovering it. Having casually heard of this place some three years since, my attention was given to verifying the report, and I think I have done so successfully.

"The locality has been cursorily described by Dr. Spry, in the Journal of the Asiatic Society of Bengal; but the fossils are incorrectly represented there as lying on limestone.

"Small fragments of fossil palm-wood are found on the cantonment side of the nullah [water-course], particularly about the Babul tree, (*c* Plan) and between it and the nullah; also, on the opposite side of the nullah an occasional specimen may be found all along the edge of the trap; but none exists on the lacustrine intertrappean limestone which is exposed in the bed of the nullah, and in other places on its further bank where it has been denuded.

"From the fragments being on the surface of the black-soil, I concluded that they must have been fossilized there; and, having been fossilized there, it was unlikely that the palm-trees from which they came could have grown elsewhere, there being no suitable soil for them; while they bore no marks of having been embedded in any other matrix. Formerly (I learnt from Dr. S.) there were cart-loads of these fragments at this place; so that, altogether, I conclude that this was both the site of the growth and fossilization of the palm-trees from which they came.

"The quantity of root-pieces too, and the mention by Dr. Spry of fine root-fibres uninjured, and two large entire root-stems which were dug up at this place by a Saugor lapidary, led to the same conclusion; and conceiving that a heated outflow of trap was the immediate petrifying agent of these siliceous fossils, I sent a person to hunt for further fragments along the junction of the trap with the black-soil. Here a Gowlee pointed out to my man a place where a log of three feet long had been dug out from the surface of the black-soil close to the edge of the trap, and, on searching here for more, I established beyond doubt that the black-soil contained fragments of silicified wood which had never before been disturbed. I had intended to have gone further, but delaying, a stone-cooly occasionally in my employ turned his hand to the spot, and he also brought me one or two large pieces of palm-wood; after which he brought more, one of which exceeded two feet long, and was about nine inches in diameter. All these came from the black-soil, and were internally of a deep black colour varying to rich chocolate.

"Wishing now to discover a tree *in situ* and so set the question at rest, I took the matter into my own hands; and for this purpose dug an adit three feet broad and twelve feet long into the trap where it

mixes with the black-soil. I then dug another across the head of this for six or seven feet, when, finding only a small piece or two of palm-wood, I pursued the original direction, and found that for six or seven feet and to within about seven inches, lay a palm-tree parallel to the first adit. It was buried at the depth of four feet in the trap and black-soil.

"Section (*d* Plan) represents the exact position with regard to the trap, and the level and divisions of the tree from measurement from a base line. The tree was silicified and divided transversely into 26 pieces, and the largest, viz. the root-extremity, was 2 feet 10 inches, while the shortest was not more than seven inches long. The total length of the tree was 31 feet 3½ inches, including 9½ inches interval between the pieces; but this, by the mode of measurement, viz. on a straight line, would be nearly made up, as by the ground-plan it will be seen that many of the pieces lay obliquely. By the ground-plan, too, it will be seen that the root had not been measured, so that the tree actually measured between 31 and 32 feet long; it was 7⅛ inches in diameter at the small extremity, one foot at the base, and 2 feet 6 inches in the root. For 20 feet of its length the tree lay in trap-lava, and nearly on a level; and for nearly two-thirds of the remaining part, viz. 11 feet, on trap with black-soil above; the last 3½ feet entirely in the black-soil, but still with the trap not far below all. The two first or root-pieces had undergone displacement, and their heaviest ends lay deepest in the black soil.

"This tree could not have been fossilized before it became recumbent, or the fall would have shattered it to pieces. For 20 feet from the root there is but one interval of an inch and a half long between the pieces longitudinally; but they have undergone considerable lateral displacement, probably from the pressure of the trap against them. This alteration in level and lateral displacement in the first 20 feet which was in the trap, appears to afford evidence of the trap having been in a yielding state after the tree had been broken into pieces, which again must have taken place after it had become fossilized. It is very evident that an unlapidified tree could not break into pieces transversely with straight even fractures; I therefore suppose that the fossilization and displacement must have both occurred whilst the trap was unconsolidated,* and must have been very speedy. The same remarks apply to that part of the tree, viz. 3 feet 6 inches, which was in the black-soil; it must have been fossilized there also.

* The succussion of an earthquake might do the latter, as the separated fragments of a previously solid rock, which has thus become a breccia, often prove.—ED.

"I have mentioned that the pieces of fossil-wood found in the black-soil are differently fossilized and of different colours; so it is here: The pieces Nos. 1 to 4 are dark, and a section of No. 5 is also dark; besides, this piece (2 feet 6 inches long) appears to have had a longitudinal fissure before fossilization, for one part is dark and the other whitish blue, the line of separation being at the crack or fissure.

"In section (*d* Plan) at piece 9 the prostrate tree had come in contact with an upright one, also fossilized in the same manner, but I do not attribute the angle here presented by the remaining third of the former, to its having met with the latter, although the prostrate, presses against the upright, stem, but to the flow of trap being at a higher level here than where the remainder of the tree lay.

"The prostrate tree must have been upturned simultaneously with the outburst of trap, and probably borne along with it for some slight distance, as trap for a short way underlies it. The roots, which are all fossilized, are imbedded in the brown chocolate soil in which the tree grew, and they could not have been much exposed to the washing of water, or there would not have been so much of the soil left about them.

"The depth of trap under which the tree was buried nowhere exceeds 4 feet 10 inches, which seems scarcely enough to have overset a tree of this height; but the tree is underlaid by trap, and therefore may have had a depth of 7 to 8 feet against it, or it might have been blown down previously or at the time of the outburst by wind.

"Section (*d. e. d.* Plan) is the upright palm-tree to which I have alluded, against which the prostrate one was laying; the dimensions are the same. Its root was found ten inches below the rest but still upright, resting upon the intertrappean bole, mixed apparently with altered trap. I cannot account for the separation of these heavy pieces in an upright trunk, unless this took place when the trap was soft, but here again the root rested on the alluvium; the tree may nevertheless have been slightly removed and the alluvium may not have been the exact spot of its growth, as it was somewhat mixed with trap.

"A detached piece was found, also probably belonging to this stem, in which the greater part of the root appeared to have rotted away and the remainder only to have become fossilized.

"In the floor of the adit, which was composed of trap, a large block of palm-wood was found completely enveloped by trap, and a small portion of black-soil with it; this piece of wood contained blue agate-veins like the fossil palm-wood in the valley of the Nerbudda.

"*Matrix.*—This is much the same as that shown in the plan, viz. black-soil and trap mixed. The black-soil about the upright tree

contains quantities of broken agates, which have fallen into it through cracks: such agates do not exist in the amygdaloid or in the trap, but on the surface of the latter and of the black-soil; they appear to be some of the latest of the igneous results, and seem connected with the trap; some contain fragments of fossils. At the end of the cross adit near the root of the tree the black-soil was mixed with trap, also at the entrance of the adit on the right hand side. In many parts the black-soil had entered deeply into the cracks in the trap, and within the black-soil again, lime was deposited. The divisions between the pieces of the tree were filled with black-soil. I did not see the tree removed, but on taking up one piece, about the centre, which lay under the trap, it was observed to be within two or three inches of the black or brown soil which was below; this differently coloured soil might have arisen from decay of the outer wood.

"About forty-five paces SW. of these trees were two others of the same kind, actually in the high road; they were about 30 inches in diameter, and from the bulging form of their roots had preserved the bole underneath them perfectly; it had the greasy appearance, on fracture, of that of Dr. Spry's "well," and was of a dark-brown colour approaching to that of chocolate. These trunks fell into many pieces when removed; they were partly underlaid by trap, but this might have been intruded, and the pure trap abutted against one. Cutting a trench by the side, the bole was seen to be horizontal and overlaid by eighteen inches of trap. Around them was the black-soil with the trap in scattered patches, and underneath the latter the brown bole.

"About 235 paces from this, in the direction of the Babul tree before mentioned, pieces of palm-wood were scattered about; and close by runs a nullah which, having been scooped out of the black-soil, has exposed the intertrappean lacustrine limestone below. The black-soil on each side has evidently been continuous."

*Observation.*—We can hardly help inferring now, I think, (though I thought different formerly) from what Captain Nicolls has stated respecting these fossil trees, that they were coeval with the existence of the lake in which the intertrappean freshwater deposits took place; that the whole was enveloped in the trap in which they are now found imbedded; and that the black-soil about them is composed of disintegrated trap.

### *Intertrappean Lacustrine Limestone of Saugor.*

From the specimens of limestone from the intertrappean lacustrine formation at Saugor presented by Captain Nicolls, we learn that it is more or less argillaceous, and therefore in some parts converted into white

chert by heat; that in other parts it is more pure, and there rendered grey and saccharoid; that in others it is chalky; in others forms the chief part of a conglomerate consisting of semi-rounded pieces of red sandstone (with *Physa Prinsepii*), but never with any portions of trap that I have seen. It is always coarse, earthy, and massive, not thin and laminated like the lithographic limestone of the "Oolitic Series" though frequently dendritic. So much does it seem to be a part of the thin limestone formation resting on "red clays" and overlying the sandstone of Bundelkhund close by, that Captain Coulthard expressed the hope that its continuity might one day be established. As yet I have never seen a specimen of *Unio Deccanensis* from Saugor.

*Limestone attached to the Fossil Bones of Narrainpoor.*

As there is a marked difference between the fossilization of the bones in the valley of the Nerbudda and those of Narrainpoor, from the latter having had their cancellated structure filled with agatoid silicious infiltration and the former chiefly with calcspar, while both from their large size appear to belong to mammals of the same epoch; I thought it would be interesting to examine the concretionary limestone attached to the latter, and, taking portions from the canals of the large vertebræ (presented by Captain Nicolls) for this purpose, I found it to be earthy, dendritic in the mass, more or less compact, of a whitish yellow colour, and infiltrated with agate like the bones to which it was attached. It differs from the earthy portions of the intertrappean lacustrine formation about Saugor in being harsher to the feel, less argillaceous, less white, and not so chalky, while it more nearly approaches in general character the modern concretionary limestone called "Kunker"; at the same time it is by no means identical with the latter. Perhaps it is of intermediate age between the former and the latter, while it is again modified to a certain extent by agatoid infiltration; but all three having been formed probably in a similar manner, it would apparently be in vain to search for mineral characters by which the specimens of either may always be distinguished.

*Ossiferous Conglomerate.*

From Captain Nicolls' notes, confirmed by his specimens, the following additional information is abstracted respecting the ossiferous conglomerate of the valley of the Nerbudda. Commencing from Burman Ghât, which is situated on the north bank of the river Nerbudda, about seventy-four miles south of Saugor and fourteen from Nursingpore, he states, that immediately below the town is a bank of conglo-

merate 80 feet thick by measurement; it is coarse below, and fines upward into a friable sandy deposit; throughout it is more or less infiltrated with calcareous matter, and the base of this scarp being concealed by detritus, the utmost extent of the formation downwards could not be determined. At the depth of 80 feet, Captain N. found the cranium of an elephant, tooth of a horse (?), and bones of an animal larger than a camel, together with shells of univalves and bivalves now existing in the locality, viz. two species of *Unio*, one, the large, common (?) thin species of India, and the other about half the size and thicker, which Captain N. informs me has been pronounced by Mr. J. de C. Sowerby to be *U. cæruleus;* a *Cyrena*, also stated by the same authority to be *C. cor; Paludina* and *Melania*. All these shells, though they are more or less filled with calcspar where not penetrated by the conglomerate, are white and but barely of sufficient consistence to hold together, in fact in much the same state as the bones would be but for their originally more compact structure. In the dry bed of a stream opposite to Burman Ghât, on the south bank of the river, Captain N. found tusks of different elephants, as well as their crania, and those of hippopotamus, buffalo, and deer; the conglomerate bank here is only 30 feet high. Further up the river on the same side, about a mile from Burman Ghât, or a little above the Pandoo Khond Islands is the village of Khan Ghât, and between this and a large Gowlee's village, a little further on upon the northern bank of the river, Captain N. found several bovine crania. About four miles and a half from Burman Ghât, still further up on the south side, is Subonee Ghât, close to and on the eastern side of which the Omer Nudi enters the Nerbudda, in the banks of which both Dr. Spilsbury and Captain Nicolls found many fossil bones, partly in the coarse and partly in the fine deposits of the ossiferous conglomerate. But it is beyond this again, viz. between the place last mentioned and Jubbalpoor, and between the latter and Mundela, which has been unexplored, that Captain N. considers the most interesting part of this locality, and that which will probably afford most fossil remains.—Although the cancellated structure of the fossil-bones from the conglomerate in the valley of the Nerbudda, which were presented by Captain Nicolls, is chiefly filled with calcspar, they are of three kinds, viz. dark-brown, compact; grey, infiltrated with calcspar; and white, cretaceous; together with compact argillized wood, like that of Perim Island. The compact, dark-brown bones correspond with those of Perim Island, where there are also two kinds, viz. light and dark-brown, the depth of colour merely depending on the quantity of oxide of iron in the calcspar with which the Haversian canals and

cavities of the cancellated structure are filled; but I have never seen any bones from Perim Island, not even the tusks of the elephants, in a cretaceous state, as they are at Burman Ghât; perhaps it is position, &c., and not time, that we are to look to for an explanation of this diversity.

On the other hand, the bones sent from Narrainpoor, to which I have above alluded, and which come from the water-shed apparently of the Sonar, a tributary of the Ken river, (at a point where the sandstone and limestone of Bundelkhund meet the trappean and intertrappean lacustrine limestone formations of Malwa, according to Captain Franklin's Map, As. Research. vol. xviii.), are all silicified, infiltrated with silex, and the fossil-wood equally hard. "Argillized" would perhaps better designate the state of the fossil-wood both in the conglomerates of the Nerbudda and Perim Island, than "silicified": for though compact it yields to the knife and breaks with a rough uneven fracture, which is quite different to the impression conveyed by the latter term; some of the specimens from Perim are also partially black and carboniferous. The greater part of the wood, too, in the intertrappean strata of the Island of Bombay, which have now been classed with the Eocene formations is, though still more or less black and carboniferous, almost entirely argillized and for the most part sectile: so that there is not much difference between the states of the wood in these two deposits.

Of the existence of "trap pebbles" in the ossiferous conglomerate, Dr. Malcolmson states that he observed them in it at the Island of Perim as well as in the "cornelian conglomerate" of the Rajpipla Hills; but Dr. Lush expressly excepts them in the conglomerate of Perim Island and the coast of Khattywar.

I cannot find a trace of trap pebbles in any of the portions of this conglomerate (which are attached to the fossil bones from Perim Island) that are in the museum of the Asiatic Society of Bombay, and these are very numerous; but in the portions attached to the fossil-bones from the upper part of the Nerbudda at Burman Ghât, which were presented by Captain Nicolls, trap pebbles of the kind I have called "trappite" are unmistakeable.

*Neocomien Fossils from Bagh and its neighbourhood, presented by* Lieut. R. H. KEATINGE, Bombay Artillery.

Passing down the river Nerbudda and leaving the trap-plateau of Malwan, we come, according to Captain Dangerfield's geological map, almost immediately upon the town of Bagh, which is situated about 22 miles from the Nerbudda and nearly due north of Chiculdah; about 145 miles from the sea and about 850 feet above its level.

At p. 237 of this Volume it will be seen that I inferred the existence of a "coralline limestone" here, and, after giving a description of it, concluded with the following paragraph :—

"It is at Bagh, then, that quarries of this limestone appear to exist, and it seems more connected with the Oolitic Series than any other formation. I place its description here for the present, merely adding, that I think it deserving of further examination on account of its peculiarities, and the probability of its yielding fossils which might determine its geological age."

Fortunately this has now been done; for Lieut. R. H. Keatinge, in company with Mr. J. H. Blackwell, the Government Mineral-Viewer, having visited Bagh and its neighbourhood a few months since in quest of iron-ore, found at the cave-temples and in the neighbourhood of this town the following fossils *in situ*, which reached the Society from Captain Keatinge in the month of April last :—

Ammonites. (A fragment).
Brachiopoda. *Rhynchonella*, Fischer.
Pectinidæ. *Janira*, Schumacher.
Echinoidea. *Toxaster* Ag. and *Nucleolites, (ano in sulcum)*. Lam.

Of these the fragment of ammonite is useless as regard specific distinction, but the *Rhynchonella* is so like *R. sulcata* given by d'Orbigny as a characteristic fossil of the Neocomien age, that but for being a little more numerously plicated it would be the same.* The *Janira* very like *J. atava* given also as a characteristic fossil of this formation;† this genus again, according to d'Orbigny, does not appear *before* the Neocomien age. *Toxaster* and *Nucleolites* not only do not appear before this epoch, but have their maximum development in it. So that these few fossils determine the existence of Neocomien deposits at Bagh.

But what is particularly interesting here is the correspondence of the specimens of *Janira* with those which I found on the south-east coast of Arabia, and which, as I had none from thence with the flat upper valve, left me in doubt as to the genus of the Pectinidæ to which they belonged. The moment however that I saw those from Bagh, both the nature and identity of the Arabian fossils were revealed. In the second edition of my memoir on the geology of the south-east coast of Arabia‡ I thought these lower valves must belong to *Plagiostoma*, but at the same time I likened them strongly to *Janira*, which the Bagh fossils have proved them to be.

* Cours. Elementaire de Paleon. et Geol. Strat. v. ii. p. 602.

† *Idem*, p. 601.

‡ "Geol. Papers on Western India," p. 607 (of which see a notice hereafter).

For the sake of comparison with Bagh, I give the following general section of the scarped face of the south-east coast of Arabia :—

| | |
|---|---|
| White limestone..... | 2,000 ? feet. |
| Red argillaceous shales and coloured limestones. | 1,000 ? „ |
| Sandstone ..... | 1,700 ? „ |

It is among the argillaceous shales, &c., which are of all colours, though chiefly red, that several species of *Janira* exist as well as Ammonites, and Echinoidea of the genera *Discoidea*, *Pygaster*, *Diadema* and *Salenia*, together with *Exogyra*, an oyster like *O Marshii*, and myriads of *Orbitolina* d'Orbig., plainly pointing out that this part belongs at least to the Cretacean Period.

The strata at the caves of Bagh, I learn from Mr. Blackwell and Dr. Impey,* consist of:—

| | |
|---|---|
| Red argillaceous limestones and clay-strata..... | 15—20 feet. |
| Sandstone ..... | 100 „ |

It is here again among the red strata that the fossils sent by Captain Keatinge were found; and I learn from Mr. Blackwell's specimens that the limestones are of different degrees of purity and hardness, viz. compact blue and red, breaking with rough fracture; red and yellow coralline,—that to which I have already alluded; fine, soft, argillaceous, of red and yellowish-greenish white colours; while below all lies a stratum of "white clay-stone in places full 20 feet in depth" according to Dr. Impey, after which comes white sandstone: this is the colour of the sandstone shown me by Mr. Blackwell; but Dr. Impey also states that in some parts it is "as dark as copper, in others slightly reddish, which is the hardest and finest variety, and lies *superior* to the pure white" (*loc. cit.*); again Mr. Blackwell adds that it is conformable to the argillaceous series. Hence it is very evident that the upper member consists of variously coloured, but chiefly red, clays, shales, and limestones of different degrees of purity, gradually passing into the lower member, which consists below of pure white sandstone.

On comparing, therefore, the fossils and the strata in which they are found at Bagh and its neighbourhood, with those on the south-east coast of Arabia, we can come to no other conclusion that I see, than that part, at least, of the coloured strata in both localities belong to the Neocomien division of the Cretacean Period.

I would also add here, that there is a remarkable similarity, if not an identity, between Mr. Blackwell's specimens of limestone from

* Description of the Caves of Bagh, p. 546 of this Number.

Bagh and those from Tendukera about 60 miles below Jubbalpoor, among which this gentleman has also found a rich development of argillaceous iron-ore mixed with limestone. The coloured strata on the south-east coast of Arabia are also characterised by their ferruginous nature, so that at all three places we get similar limestones and similar developments of iron-ore, with the same kind of fossils in two, viz. at Bagh and on the south-east coast of Arabia.

*Discovery of Nummulitic Limestone in the Rajpipla Hills, by the late* Major G. FULLJAMES, Bombay Army.

Passing still further down the Nerbudda we come to the Rajpipla hills not far from Broach, among which is situated the village of Wasna, which is about 55 miles below Bagh and the locality of Major Fulljames's nummulitic limestone.

It will be observed at p. 249 of this volume* that when I last alluded to this limestone I had only made out the existence of *Orbitoides Prattii* in it, and therefore had not satisfactorily proved that it belonged to the Eocene era; but in publishing another edition of my "Summary"† I have had to re-examine it, and have found two distinct species, of which the following are descriptions:—

*Nummulites* (*Ramondi, mihi*). Discoidal, thick; margin angular acute, slightly wavy. Surfaces smooth, marked with lines for the most part simple, radiating from the centre to the circumference. Spire very regular, consisting of nine whorls; chambers also very regular, a little longer than broad, reflected; septa slightly curved. Diameter $\frac{9}{16}$ inch, thickness $\frac{3}{16}$ inch.—*Loc.* Wasna in the Rajpipla Hills near Broach. In red and yellow, compact, earthy, argillaceous limestone.

*Obs.*—This beautiful little nummulite closely resembles *N. Ramondi*, Def., (Foss. Num. de l'Inde, pl. vii. fig. 13).‡ It is associated with *Operculina, Orbitoides dispansa*, and small shells. From being imbedded in a ferruginous rock, the parts which contained animal matter have become red, while the rest remains white, hence its beautiful appearance. Having had to examine it by sections, I have observed that the parts covered with and permeated by that substance which I have likened to the "cuticle of shells," (but which the Authors of the work just mentioned more properly liken to the epidermis of *Echinoidea* and the epitheca of polypes), are infiltrated with red oxide of iron; the

* Summary of the Geology of India. † Geological Papers on Western India.

‡ As the authors of this work (MM. le Vicomte d'Archiac and J. Haime) have taken notice of some of my geological papers, which have been published in this Journal, I shall take this opportunity of answering some of their remarks.

interseptal spaces white, but the interseptal vessels or canals red; the marginal cord white, but presenting in its transverse section red points indicative of the position of the marginal canals; and the external surface of the marginal cord traversed by longitudinal lines indicative of the previous existence of spiculæ such as I have described in *Operculina Arabica* (Ann. and Mag. Nat. Hist. vol. x. p. 161, 1852).

Independently of the Authors of the Foss. de l'Inde stating, p. 54, "Or, nous nous sommes assurés, par des observations très-multipliées, que dans aucune des espèces de ce dernier genre [Nummulites] il n'existe rien qui puisse rappeler la corde spiculaire ni le plexus marginal signalés par M. Carter dans l'Operculine d'Arabie."—I have had here the opportunity of comparing an *Operculina*, closely allied to *O. Arabica*, which happens to be imbedded with this nummulite, and precisely in the same condition as regards ferruginous infiltration; and on the surface of the marginal cord of the *Operculina* are beautifully shown the longitudinal lines indicative of the presence of spiculæ, which, when placed side by side with the nummulitic, only exhibit the difference that they are a little more faintly marked in the latter. Both these fossils are most favourably circumstanced for exhibiting the points mentioned; they are hard but in a comparatively soft matrix, which renders their extrication easy without scratching, so that they fall out with shining surfaces; both are beautifully regular in structure; and the contrast between the red infiltrated parts and the crystalline white ones enables the observer to distinguish the limits of the two in each, with the greatest nicety. No one can witness these fossils in comparison with recent *Operculina*, without feeling convinced that the red parts in the former and the green ones in the latter were formerly occupied by sarcode, and that the sarcode permeated the walls of the chambers and formed a soft substance on the surface, any more than that the spicular cord existed in all three, as represented by that ridged surface shown so distinctly in Dr. Carpenter's figure of *N. lævigata*, 7 *c*, pl. iv. Quart. Jl. Geol. Soc. vol. vi.; and with the openings of canals from the marginal plexus, in MM. d'Archiac and J. Haime's fig. 1. *e*. of the same nummulite, pl. iv. *Op. cit.*

I have also lately noticed, that in some specimens of *Operculina Arabica*, the spicular structure is not only present on the margin, but is extended inwards over the interseptal spaces between the last five or six chambers.

*Nummulites Broachensis*, H. J. C. (*nov. sp.*?) Discoidal, thick; margin angular acute. Surface smooth, presenting punctæ arranged spirally, without striæ. Spire regular, consisting of six whorls; cham-

bers longer than broad, septa reflected, curved. Diameter $\frac{5}{48}$ inch, thickness $\frac{2}{48}$ inch. *Loc. idem.*

*Obs.*—At first I thought all the little nummulites in this argillaceous limestone were the same, but the former evidently belongs to the *Plicatæ et striatæ*, and the latter to the *Punctulatæ*, (d'Archiac et Haime); and answering to none of their species, from the spiral arrangement of the punctæ being without striæ, I have taken the advantage of giving it the above specific designation, to record the fact of the existence of Eocene Strata near the town of Broach, about fifty miles up the river Nerbudda.

Thus we see that at Bagh we have Neocomien strata; lower down the Nerbudda, deposits of the nummulitic age; and at the mouth of the river, viz. at Perim Island, as well as along its course, the Ossiferous Conglomerate; showing that along its valley it presents the same formations successively as the Ganges and Indus. May we not look for a similar set of deposits towards the debouchements of the other great rivers of India, viz. the Godavery, Cauvery, &c.?

*Discovery of beds of Lignite under the Laterite at Rutnagherry.*
By Dr. de Crespigny, Assistant Surgeon H. C. S., Bombay.

I have just suggested the existence of deposits from the Neocomien Age downwards, along the lower parts of all the great rivers of India, and the following suggests, as far as the Eocene Era goes, deposits at least of this epoch all round its shores. Rutnagherry, the place at which these beds of lignite have been found, is situated on the western coast of India, about 120 miles south of Bombay. In briefly describing them, Dr. de Crespigny, to whom we are indebted for this important addition to our knowlege of the intertrappean formations, states, in his note dated the 16th July 1856, that in a quarry near Rutnagherry, where he is residing, beds of lignite are found, and that "1,000 yards further inland a well was sunk through the laterite, which gave the following section:—

"Soil and detrital conglomerate, a few feet.

| | | |
|---|---|---|
| Laterite (soft below) | 35 | feet. |
| Compact iron-stone | 1½ | „ |
| Lignite<br>Blue clay | 27 | „ |
| Water, yellow gravel. | | |
| Trap." | | |

As the existence of these strata was casually noticed by Dr. de Cres-

pigny and I did not see his observations until the rains had commenced, he had not the means, when I wrote to him on the subject, of sending me more than the above section with specimens, but he will resume his researches as soon as the subsidence of the water in the quarries and wells about Rutnagherry takes place; meanwhile there is sufficient in this section and the specimens to attach great interest to the subject.

In his note, he further observes—"The lignite underlies the solid laterite, which Voysey and you declare to be of volcanic origin." This is his reply to the question whether it was a laterite of detritus, or what I have termed genuine laterite, viz. that which contains no foreign material and appears to be a mere decomposition of trap or basalt; because if this 35 feet of laterite be the remains of a trappean effusion, then these strata, so far as this goes, are most assuredly similarly situated to the intertrappean lacustrine strata, of the Island of Bombay, at least.

But to return to the specimens. I learn from these that this formation consists above of an argillaceous, gravelly deposit, speckled white and grey, in which are imbedded black lignite, mineral resin, and pyrites, and below this, fine blue plastic clay; all of which are identical with the lignite, mineral resin, pyrites, and blue clay of the beds which underlie the detrital laterite on the coast of Travancore; but the speckled argillaceous deposit, in which the lignite is imbedded, most strikingly resembles much of the intertrappean lacustrine strata of Bombay, among which wood also exists, not exactly in the state of lignite, but argillized and slightly coal-bearing; that of the Rutnagherry strata also frequently approaches the former state, in being more or less earthy, soft, and sectile; while the difference in the presence of coal may be owing to exposure to a greater degree of heat as will be more particularly mentioned hereafter.

No shells have yet been found, so that whether these deposits took place in salt or in fresh-water is not yet known; but the pieces of lignite are much rounded by attrition, and there are carpels and seeds apparently of some large tree, among the specimens, so perfect, that if the forms of the vegetable remains generally be so well preserved as these, there will not be much difficulty in determining the *Flora* of this deposit. To its probable geological age, as well as that of the Bombay strata and those near Rajamundry, we shall come by-and-bye. I also noticed among the lignite, round warty-looking pieces like those so common in the Bombay strata, and which I at first supposed to be

fungoid excrescences, but which subsequently were proved to be what I have termed them, from having been found *in situ* imbedded in the bark in which they grew.

*Description des Animaux Fossiles du Groupe Nummulitique de l'Inde, précédée d'un Résumé Géologique et d'une Monographie des Nummulites, par* le Vicomte d'Archiac *et* Jules Haime. Large 4to. 32 Plates. Paris, 1853.

It is right that notice should be taken here of this work, not so much for answering certain remarks in it on matter which has appeared in this Journal, but for the purpose of commending it to the student of Indian Geology. Written by men of the highest proficiency in Geology, Geography, and Natural History, on a group of fossils (viz. the Nummulites) at once of extreme interest and before in almost inextricable descriptive confusion; especially devoted to Sind and its fossil remains generally; it becomes not only an indispensable work to the student of Geology in India but to the Geologist throughout the world. The materials from Sind, as will be seen by the "Preface," were chiefly supplied by the Geological Society of London, and the work written by Authors, one of whom is the distinguished Secretary of the Geological Society of Paris.

To state what the work contains is much easier than to review it, and this is best done perhaps by observing, that the first part is devoted to the Nummulites generally, and the second to the other fossils of the Nummulitic Formation in Sind, especially. It abounds in references, and lithographic illustrations of the finest kind, the accuracy of which again, in delineation, is guaranteed by the indubitable correctness, acumen, and judgment of the Authors.

Amongst the remarks made on papers published in this Journal, I shall only allude to two here, viz. that on the grouping of the Eocene and Miocene strata in my Summary of the Geology of India,* and that on the identity of *Orbitoides Mantelli*, d'Orb., with *Orbitolites Mantelli*, H. J. C.;† which, with the rest, I have already endeavoured to answer in the reprint of "Geological Papers on Western India, &c." before mentioned; but as the "Note"‡ in answer to the remark on the Eocene and Miocene strata equally refers to corresponding parts in this volume *(loc. cit.)* I shall here reprint it entire.

It might appear that I have servilely followed the arrangement

* This volume, pp. 248 *et* 292 respectively.

† *Idem*, p. 138.

‡ Geol. Pap. Western India, p. 743.

proposed by the Vicomte d'Archiac and M. J. Haime, but a perusal of the second edition of my Geology of the South-east coast of Arabia in the work just mentioned will show that I was compelled to it independently of their valuable suggestion. The following is the "Note" to which I have alluded:—

"To those who have read both editions of the foregoing 'Memoir' on the Geology of the south-east coast of Arabia, the necessity of grouping the strata under the head of Miocene in the first edition with the Eocene strata in the second edition, will have been obvious; at the same time it will be seen, that if this has been done on the coast of Arabia, it must be done on the western coast of India, for the grounds on which a similar series was established on the latter were based upon its assumed existence on the former.

"That this should be the case receives further confirmation from the observations of the authors of the 'Fossiles du Groupe Nummulitique de l'Inde,' p. 358, who, in commenting on this part of my 'Summary,' observe, respecting the Miocene Group:—L'ensemble des formes ne prouve pas qu'ils appartiennent à cette période, et jusqu'à une démonstration complète, nous les regarderons comme faisant partie de la formation inférieure. * * * Nous sommes d'autant plus conformé dans cette conclusion, que nous avons observé des Nummulites dans les echantillons d'espèces placées, par M. Grant comme par M. Carter, dans les couches de Cutch qui n'en referment pas (*Ostrea vesicularis, Natica angulifera, Solarium affine, Voluta jugosa, Terebellum obtusum, etc.*). Nous continuons par conséquent à ne commencer ici la formation tertiaire moyenne qu'avec les couches inférieures a ossements de grands mammifères.

"We shall now do the same, but before making this change let us see what additional information respecting these formations on the western coast of India has been obtained since my 'Summary' was compiled.

"In the first place, it will have been seen by the foot-note, p. 696 *et seq.*, that the supposed nummulitic limestone from the neighbourhood of Broach on the river Nerbudda is undoubtedly of the Eocene era.

"Secondly, the great number and forms of the different species of *Cerithia* in the limestone from 'Bate Island,' at the north-western extremity of Khattywar, also unmistakeably prove that this is of the same period; though the deposit was littoral, for it is not only arenaceous and argillaceous, but there is much fossilized wood among the shells.

"Further down on the outer coast of Khattywar again, is the compact, yellowish limestone made known to me through specimens brought by

Lieutenant Constable, I. N., which, in addition to the characteristic *Strombus* (*S. Fortisi*, Al. Brong.?—Foss. Num. de l'Inde, pl. xxx. fig. 17) of these formations on this coast, and other shells of Eocene form, is richly charged with *Orbitolites*, Lamarck; in which it resembles the orbitoliferous Eocene rock close to Ras Sajar on the south-east coast of Arabia (p. 599, *ante*.).

"Here, however, there is but one species of orbitolite, which in its largest size is $\frac{3}{12}$ inch in diameter and about $\frac{1}{40}$ inch thick at the circumference; the centre being a little thinner chiefly because the cells are smaller, but the whole appears to be composed of a horizontal inclined plane twisting round a vertical axis, and thus would resemble a deep-cut screw so compressed longitudinally that the whorls were made to touch each other; but with the uppermost and undermost layers united at the margin and enclosing all the rest like the last whorl of a nummulite; indeed this spire is sometimes twisted round a central cell too, like that of a nummulite. The layers thus arranged are composed of lines of cells increasing slightly in size with their distance from the centre, from which they take a spiral course to terminate at the circumference. In this structure it will be seen that they resemble *Orbitolites Malabarica*, H. J. C. (Ann. and Mag. Nat. Hist. v. ii. p. 425, 1853), of the blue, clayey, argillaceous limestone of the coast of Travancore, but the cells are much smaller, and the structure throughout finer and more compact, so that they more nearly approach *Cyclolina*, in the centre of which, as well as in *Orbitolites*, Lamarck, I have seen the same spiral arrangement.

"There can be no difficulty then in assigning *this* rock to the Eocene period.

"Lastly comes the argillaceous limestone of the Malabar Coast (to which I have just alluded), not only abundantly charged with the *Orbitolites Malabarica*, but here again in company with *Strombus Fortisi*, together with *Cerithium rude*, *Ranella Bufo*, *Cassis sculpta*, *Voluta jugosa*, *Conus catenulatus*, and *C. marginatus* (Grant, Geol. Cutch, Tert. Foss.); also *Natica*, *Turbo*, *Pleurotoma*, *Fascicolaria*, *Murex*, *Cancellaria*, *Ancillaria*, and *Cyprea*, all (new species?) closely allied in form to the figured shells of the Eocene period. The orbitolite differs very little, except in size, from *Orbiculina angulata*, Lam. (Encyclop. Méthodique, pl. 468, fig. 3), from which I infer that the latter should also be included among the *Orbitolites* of the same Author.

"There can be no objection, therefore, to considering this formation also a part of the Eocene deposits, and we have now only left the

blue clay, of which the foregoing limestone and shells being only a part, this, as a matter of course throughout the western coast of India, falls into the same category.

"Not only is lignite seen in the blue clay of Travancore, but portions of it exist also in the argillaceous limestone, as we have seen fossil-wood among the shells of the Eocene limestone of 'Bate Island.' Gyrogonites, or seeds of Characeæ, abound in the blue clay of Kurrachee with lignite; and 'Charoideæ,' we find, from Captain Vicary's statements, partly characterise the upper division of his nummulitic deposits in Sind. Gyrogonites are common in the Parisian strata, which again are equivalent to the London clay, in which are found nummulites. So that everything tends to the view taken of these formations by the Authors of the Foss. Num. de l'Inde, viz. that they should be included in the Eocene period and the next division commenced, from below, with the Ossiferous Conglomerates.

"The question now, however, which presents itself is, what are we to do with the Rutnagherry deposits, which underlie laterite, and are identical, in containing similar lignite and resin, together with blue clay, with the deposits on the coast of Travancore, now evidently belonging to the Eocene era? This seems to me not to require a moment's consideration, inasmuch as the identity, in the absence of characteristic organic remains in the latter, is sufficient to combine the two, particularly when viewed with relation to the lacustrine strata of the Island of Bombay, which, from containing the remains of batrachian reptiles (viz. frogs), whose first appearance in a fossil state, according to d'Orbigny, did not take place until towards the middle of the tertiary period or upper part of the Parisian series, brings all these formations on the western coast of India into the Eocene group of Sir Charles Lyell.

"(Does not the capping of these deposits with black basalt at Bombay, and with 'genuine laterite'—that is, laterite which contains nothing but what might come from a trappean effusion—which this is at Rutnagherry, show, that one is but another form of the other; more especially when we see a part of the top of the basalt at Bombay, close to Worlee flagstaff, passing into laterite; and does not the shining, coaly state of the lignite in the strata at the former site, compared with its dull earthy black aspect at the latter and at Travancore, point out that the difference has been occasioned by the greater heat of the molten matter that overflowed them in Bombay, thus producing a more durable condition of the effusion here than at Rutnagherry? In short, is it not the more thoroughly molten state of the former which has enabled it

to withstand the destructive agency of time, and the less molten state of the latter which has allowed it to pass into laterite?)

"What now, then, is to become of our intertrappean lacustrine formation of the Deccan? The basalt under which it lies in the Gwailgurh Hills being, according to Voysey, the same as that of the 'Pouce' in the Mauritius, is the brown old basaltic effusion of the Deccan, and not the fresh, deep, black purple one of Bombay; and who, looking at the general appearance of *Unio Deccanensis*, with its thick heavy shell converted into compact material of a deep leaden hue like that of the fossils of the Jurassic period, compared with the white *Helix* and *Lymnea* of the European Eocene, which would seem to have their types in a formation of similar age close to Cape Comorin (Specs. in Mus. Bom. As. Soc. presented by Major General Cullen), would not instantly conclude that the formations from which these fossils came could not be of the same epoch, and that the compact blue *Unio* must belong to a much older one than the white, almost pulverulent, *Helix* and *Lymnea?*"

However, we must not be guided altogether by appearances in this matter, for since the foregoing paragraph was written, I have observed, that the Rev. Messrs. Hislop and Hunter have determined the existence of *Physa Prinsepii* among the marine fossils of the infra-trappean deposit at the lower part of the Godavery near Rajamundry* which *à priori* one would conceive to be Eocene like that of the western coast of India, but as yet its geological age has not been ascertained. Again a specimen of *Unio Deccanensis* lately presented to the Society by the Rev. Mr. Hislop is quite white, not "blue," and the specimens of *Physa Prinsepii* from Saugor presented by Captain Nicolls are for the most part as white and pulverulent as the *Helix* and *Lymnea* of the Tertiary Formations, while both Mr. Hislop and Dr. Bradley inform me that the *Unio* and *Physa* are found together; so that what I have stated above goes for nothing so far as the geological age of these fossils is concerned.

In connection with this subject I should not omit to notice, that the variety in form is as great as the variety in fossilization of *Unio Deccanensis;* some specimens being oblong and others almost triangular, while the latter are more or less plicated and the former sometimes hardly at all so; the shell also varies greatly in thickness; but when several specimens are brought together, all the varieties can be so traced into each other, that those of the most opposite kind, viz. the oblong and triangular forms, fail to maintain that specific difference among a great number which seemed to be so decided when viewed by themselves.

* Quart. Jl. Geol. Soc. Lond. vol. xi. p. 365.

*Orbitolites Mantelli*, H. J. C.

With reference to the remark of the authors of the Foss. Num. de l'Inde placed opposite "*Orbitolites Mantelli*, Cart." in their "Table" p. 363, viz. "Est-ce bien l'espèce des Etats-Unis?" I can only observe, that it agrees strictly with the characters of "*Orbitoides Mantelli*" given by Dr. Carpenter in the Quarterly Journal of the Geological Society of London (vol. vi. pl. vi. figs. 20, 21, and pl. vii. fig. 31) viz. in presenting, on a horizontal section of the central plane, *circular cells* having apparently a "*concentric*" (p. 32, *id.*) arrangement; and in a vertical section quadrangular cells in the central plane, and compressed cells above and below it, hence the cells of the central plane must be cylindrical, while the variety of shapes which this fossil may assume, from the variable thickness of the mass of compressed cells, gives it at one time a plane and at another a raised surface in the centre. These characters are also presented by the other specimen which I have described and figured (Ann. and Mag. Nat. Hist. vol. xi. p. 175, and pl. vii. figs. 40 and 41, respectively), and which the authors to whom I have above alluded have conjectured to be *Orbitoides* (p. 350, *op. cit.*). But how can either of these species be *Orbitoides*, when the central plane of this fossil is composed of *oblong* chambers, arranged in *subspiral* lines running off from a centre, with their *long axes horizontally ?*—unless the opposite to these characters be deemed insufficient for a generic distinction, and a "considerable" elevation of the disc "diminishing gradually towards its margin," as Dr. Carpenter has remarked in his "Monograph on the Genus *Orbitolites*" (Philosophical Transactions, 1856, p. 195), be regarded as decisive. Still this will not be sufficient, for many varieties of this fossil do not present any elevation at all, being perfectly flat and square at the ends in a vertical section, like some of the fossils to which Dr. Carpenter has rightly restricted the term *Orbitolites*. At the same time the fossils which I have described under the head of "*Orbitolites*" are so distinct from those described under that of "*Orbitoides*" (Ann. and Mag. Nat. Hist. *loc. cit.*), that I cannot see how the two are to be included in the same genus. The respective characters of the central planes of *Orbitoides* and *Orbitolites* are given in figs. 35 and 36, pl. vii. (*Id.; id.*), and the other differences mentioned in the text.

I am by no means certain that the cells of which the central portion of *Orbitolites Mantelli* H. J. C. is composed have a concentric arrangement, and if this should not be the case, but they come off sub-

spirally, as the chambers of the central plane of *Orbitoides*, then it seems to me not improbable that these subspiral rows of cells may issue from a spiral line twisted round the vertical axis of the fossil, after the manner of the rows of cells in *Orbitolites Malabarica*, H. J. C. (Ann. Mag. Nat. Hist. vol. 2, p. 425, 1835), which I now find to be so closely allied in structure to *Orbiculina angulata*, Lam. (Tab. Encyclopéd. et Méthod. t. iii. pl. 468, fig. 3), that its place seems to be under this genus rather than *Orbitolites*, Lam. 425,—1856; but *Orbiculina pleurocentralis*, H. J. C.,* has no marginal pores any more than Lamarck's *O. adunca* (*loc. cit.*), while his *Orbitolites*, which Dr. Carpenter has very properly taken as the type of this genus, has ;—so here again adjustment seems necessary.†

* The following description of this fossil, which was found in company with *Orbitoides Mantelli*, d'Orb., is extracted from the "Geological Papers on Western India," p. 593 :—

"*Orbiculina pleurocentralis*, H. J. C. (*nov. sp.*?) Elliptical, thin, flat, wavy. Surfaces presenting a corresponding prominence on each side, situated laterally and towards one end of the ellipse, covered with minute tubercles, which, becoming larger excentrically, pass off into moniliform rows, that, after a subspiral course, terminate on the margin. Internally consisting of a single plane of oblong chambers filling up the intervals between the rows of tubercles, with their long axes horizontal and across their spiral course. Margin inflated, round, smooth, without apertures. Length of largest specimen 7-24ths inch, breadth 5-24ths inch, thickness at the prominence a little more than at the margin, which is 1-60th inch. *Loc.*—Takah, SE. coast of Arabia.

"*Obs.*—This beautiful little pearl-white fossil abounds among the *Orbitoides* and *Orbitolites* just mentioned. It bears the same relation in point of simplicity of structure to *Orbitoides* that *Operculina* bears to *Nummulina*. It also closely resembles, in the section and contour, fig. 2 *c* of Lamarck's *Orbiculina adunca* (Tabl. Encyclopéd. et Method. pl. 468). Should we choose to assimilate this fossil to *Operculina*, we have only to draw an *Operculina* with three or four whorls and reflected chambers on a piece of paper, and then join the septal divisions of each whorl together and strengthen these lines while we lighten that of the spire; the spire dividing the whorls will then represent the septa in *Orbiculina*, and the septa being joined end to end in *Operculina*, will represent the lines of tubercles in *Orbiculina*.—A vertical section through the long axis of this fossil shows that the short part, behind the prominence, is thin at the margin, while the margin of the long part, or that in front of the prominence, is inflated."

† Since the above was written I have received Dr. Carpenter's second valuable "Memoir" on the Foraminifera (Phil. Trans. p. 547, 1856), by which I observe that all this adjustment has been made. *Orbitolites Malabarica* and the *Orbitolites* of Khattywar (p. 630) should now come under the term of "*Orbiculina*" respectively; and *Orbiculina pleurocentralis* under that of "*Heterostegina*," d'Orbig. But *Orbitolites Mantelli* H. J. C. is still unprovided with a proper name, inasmuch as it is neither *Orbitolites*, Lam., nor of the type of *Orbitoides Prattii*.

Hence then, if the structure of *O. Malabarica* should be the same as that of the centre of *Orbitolites Mantelli*, H. J. C., we should have *O. Malabarica* bearing a similar relation to *Orbitolites Mantelli*, H. J. C., that the *Orbiculina* described (p. 634) bears to the central plane of *Orbitoides*, and *Operculina* to that of *Nummulina*; but the arrangement of the cells, forming the centre of *Orbitolites Mantelli*, H. J. C., has yet to be discovered; it evidently consists of a plurality, but whether they come off spirally from a vertical axis or not, I have, up to this time, been unable to determine; a concentric arrangement would be more a character of *Orbitolites* Lamarck, than of *Orbitoides* d'Orbigny.

*Cyclolina*, d'Orbigny, *not confined to the Cretaceous Period.*

With reference to the two species of *Nautili* which chiefly abound in Sind (see p. 254 of this vol.) and to which the Authors of the Foss. Num. de l'Inde allude, I have added a *Foot-note* to the second edition of my "Summary of the Geology of India (*op. cit.* p. 700), not so much to state that they are the same as those described in this work, as to introduce, in connection with them, the fact of the existence of *Cyclolina* during at least part of the Eocene period, and thus to correct an error which I had fallen into through d'Orbigny's having inferred that this fossil was confined to his "Cenomanien" division of the Cretaceous Era. The following is the "Note" to which I allude:—

"The first of these *Nautili* is *N. Deluci*, d'Archiac, pl. xxxv. figs. 2, 2*a*; and the second *N. Labechei*, d'Arch. et J. Haime, pl. xxxiv. figs. 13, 13*a*, and pp. 337, 338, *op. cit.* In examining a specimen of the former, I have just had the good fortune to discover that the contents of the last chamber are charged with *Cyclolina* and *Alveolina elliptica*; I state 'good fortune,' for it will have been seen that by following M. Alcide d'Orbigny's 'Tableaux' (Course Element. de Paléont. &c.) I have made it the signal for recognizing the commencement, in the descending order, of the *Cretaceous Series* on the south-east coast of Arabia, whereas it is by no means limited to this period. At first I thought, from the great resemblance of *N. Deluci* to *N. triangularis* of the Cretaceous series, that they might be the same, and that probably the hills about Hyderabad in Sind where I had found *N. Deluci in situ*, and had not observed nummulites, might be a part of the cretaceous deposit; but on examining specimens of the limestone charged with *Cyclolina pedunculata* from the Buran river not more than thirty miles from Hyderabad, I find that there are also many small nummulites present very like if not the same with

*N. latispira*, Menegh. (Foss. de l'Inde, pl. i. fig. 6); while in limestone bearing the same species of *Cyclolina* from other but unknown parts of Sind, there are small nummulites of the group *Punctulatæ*. Now, the *Cyclolina* in all being the one mentioned and hardly deserving of a different designation from d'Orbigny's *C. cretacea*, while it has been found throughout the Cretaceous Series on the south-east coast of Arabia, it follows:—1st, that this fossil has, perhaps, the widest range as to time of all the larger species of Foraminifera, and 2nd, that the summit of the great scarp on the South-east coast of Arabia is by no means so evidently confined to the Cretaceous Series as d'Orbigny's range of *Cyclolina* alone had led me to infer."

*Geological Papers on Western India, including Cutch, Sind, and the South-east Coast of Arabia, to which is appended a Summary of the Geology of India generally.* Edited for the Government by Henry J. Carter, Assistant Surgeon H. C. S., Bombay. Royal 8vo. with an Atlas in 4to. containing 32 Maps and Plates. Bombay, 1857.

Of this compilation, to which I have several times alluded above, more need not be stated than what is contained in the following paragraphs, which have been extracted from the "Preface":—

"The plan adopted in the arrangement of the compilation has been, first to introduce the reader to the Geology of the great Trappean region of Western India, and then to carry him round its outskirts, in order that he might be brought acquainted with the Geological formations of India generally. His attention then is directed to the Geology of Cutch, afterwards to that of Sind, and, lastly, to that of the neighbouring coast of Arabia.

"For this purpose almost all the Geological Papers that have been written on these different parts have been reprinted *in extenso*, by which the reader will not only have the full advantage of the Authors' descriptions, but the facts contained in them in their own words. Of the papers which have not been printed entire, chiefly to avoid repetition of what appears in other parts of the volume, abstracts have been made; and of the few which have not been printed at all, whatever they contain worth remembering is embodied in the papers which have been printed *in extenso*. So that with the exception of this matter, altogether only amounting to a few pages, the book comprises all that has been written on the subject, and therefore all that the Geologist of Western India can at present obtain, to lead to future discovery.

"It must not be thought, however, that this compilation embraces

an introduction to Geology; this the reader must have already acquired before he can even understand its contents; nor must the Economist expect to find all that information here which he desires, for such detail would be incompatible with the object of the work; but both will find in it reason based on a geological knowledge of the structure of the earth in India, or, in other words, scientific Indian Geology; a light which though dim at present, will brighten as it is used, and at length lead to that development of mineral resources which the mere Economist would grope for in the dark, without finding, to the end of time.

"All the papers reprinted *in extenso* are unaltered from their original form, with the exception of those by the Rev. Messrs. Hislop and Hunter, and those by the Editor. The former of which have received several valuable alterations and additions from the Rev. Mr. Hislop; and the latter have not only been re-cast in many parts, but have undergone as much alteration, addition, and correction throughout as the Editor had time to give them while they have been rapidly passing through the press.

"To the Editor's 'Summary of the Geology of India,' which was included in the Government list, and has therefore been printed at the end of the volume, the Editor has only been able to add '*Foot-notes*' suggestive of the future alterations that should be made in it; being unable to devote that time to a re-arrangement of the whole which such alterations would necessitate.

"Further, that the compilation might be made as useful as possible, not only the maps and plates belonging to most of the papers have been lithographed to accompany them in the form of a separate Atlas, but the Editor has also added an Alphabetical Index for reference to their contents generally."

*Encrinitic Limestone from above the Western Ghâts.*

Of this interesting specimen, which was presented to the Society by Dr. de Crespigny, the latter states:—"In examining a bag of stones the other day which was found in a lumber-room of the Revenue Survey Establishment here (at Rutnagherry), I found among bits of schiste, lignite, scoriæ, quartz of sorts, &c., a piece of what looks like argillaceous limestone (siliceous or metamorphosed) containing fossil impressions of Crinoid Stems (?); most of the specimens were labelled from Konkunkoss above the Ghâts."

This specimen I have also examined; it is of a blue colour, and, if not metamorphised by heat, is so from age and other circumstances, for,

except where it is weathered, no trace hardly of its fossil-contents can be observed, but, where it has been exposed, there the remains of encrinitic stems are unmistakeable, empty or filled with rhomboidal calcspar; and considering the position as to locality and contents where it was found by Dr. de Crespigny, and the specimen being too insignificant in character to conceive that it ever formed part of a cabinet brought from Europe for instruction, there seems to be every reason to conclude that it did come from some part of Western India, and probably with the other specimens so labelled, from "above the Ghâts."

*Jurassic Fossils from the Somali Country.* Presented by Captain R. F. Burton.

Among a small collection of fossils collected by Captain Burton and his party in the Somali country, are, besides a few Tertiary, the following from the Jurassic Series :—

*Belemnites canaliculatus,* Schloth. (Grant, Geol. Cutch, pl. xxiii. figs. 2, 3; Trans. Geol. Soc. Lond. vol. v., and pl. xvii. *id.* this vol.)

*Terebratula intermedia,* Sowerby, (*id.* pl. xxii. fig. 10, and pl. xvi. *id.* this vol.)

*T. Microrhyncha,* Sowerby, (Colonel Sykes on Fossils of Cutch, pl. lxi. fig. 7, *id.* and pl. xxi. *id.* this vol.)

Besides these there are several other Terebratules, all of which, if not so much weathered, might find their identifications in figs. 13, 15, and 16 of the Cutch fossils (*loc. cit.*)

*Arca* (*species?*)—Subtrigonal, muchel ongated posteriorly. Length 2 inches, width 1 inch. Ribbed and marked on the surface like *Cucullæa virgata,* Sow. (pl. xxii. fig. 1, *loc. cit.*), but by no means the same species.

*Exogyra auricularia,* Goldf. *mihi* (pl. 87, fig. 2). Subsquare, $\frac{10}{12}$ inch broad and long, $\frac{6}{12}$ inch deep. Bearing the impression of part of a Terebratula to which it had been attached.

It is interesting to find that the principal part of these fossils are identical with those of the Jurassic strata in Cutch. Some of the Terebratules, Lieutenant Speke assured me that he picked up a few miles inland, opposite Bunder Ghoree, at a height exceeding 6,000 feet.

## Art. XVII.—*On the Transition of Trap into Laterite.* By Assistant Surgeon F. Broughton, Civil Surgeon, Kolhapoor.

Presented 12th March 1857.

This interesting subject has long engaged the attention of geologists, and different theories have been propounded as to the process by which the hard unyielding rocks—basalt and trap, are converted into the easily wrought material—laterite.

2. Having lately enjoyed peculiar opportunities for observation in the extensive lateritic field of Rutnagherry, I am disposed to think that the exact change has not been hitherto perfectly understood.

3. The opinions of Voysey are cited in Mr. Carter's admirable summary, and his description of its origin as by transition through clay is considered the most probable although still doubtful theory.

4. My recent researches in the wells and quarries of Wagotana enable me to corroborate this view, although the presence of another agent, not alluded to by authors, is, I think, requisite for the conversion of the one rock into the other.

5. It will, I trust, become apparent from the evidence I am about to adduce, that the composition of laterite and trap is not truly isomeric, so that simple transition is impossible. I believe the presence of water is essential to this action. By its means a sort of double decomposition appears to take place. The trap is resolved into red clay, and the clay in combination with water becomes laterite.

6. We are all, I think, too much accustomed to speak of this and similar geological transitions in the past tense, and to overlook important changes which are carrying on their ceaseless operation within the limits of actual observation.

7. In the numerous sections I had opportunities of examining, I never found the trap and laterite in contact. At whatever depth—30, 40, or 50 feet—a layer of homogenous and intensely red clay invariably intervened, and it was always close to this seam that the springs were found in the wells. This layer is always exceedingly soft until after exposure to the air. Water evidently plays an important part in the

transformation. The intense red colour disappears, and the mass assumes the cancellous structure peculiar to laterite.

8. This relative position being invariable, I must express my inability to understand how (as Mr. Carter supposes) laterite may sometimes be found resting upon non-trappean rock.*

9. I must suppose all laterite to be similarly formed. That which is now seen capping lofty hills must necessarily have been formed from the hill previous to its elevation. In either its primary soft and caseous condition, or its consequent compact form, it seems to be difficult to imagine the capability of its removal from the site upon which it was produced, without such derangement of structure as to render it incapable of recognition.

10. I forward specimens exhibiting this interesting change, premising that Nos. 4 and 5 can never be correctly estimated except in their natural soft condition. They are for demonstrative purposes nearly ruined by exposure.

11. No. 1 is a specimen of trap cut three feet below the laterite, and upwards of thirty feet from the surface. This is as usual firm and compact, and resists any but the most violent means of fracture. No. 2 is trap partially changed and already becoming more fragile, and distant about 18 inches from the laterite. In No. 3 it is seen still more softened, and breaks with little violence under a hammer. No. 4 is the layer of red-coloured clay now hard but always soft *in situ*. No. 5 is the upper layer of clay segregating into laterite and as soft as soap before exposure to the air. No: 6 is the laterite of which the houses and bridges of this part of the country are constructed.

12. Easily cut out in blocks of any size required, it is remarkably fitted for building purposes, and after acquiring hardness by exposure it is exceedingly durable. Works of considerable magnitude have been executed with this most useful rock, which has been for many years quarried in Wagotana. To give an idea of the ease with which it is manipulated, Colonel Scott made piping for an aqueduct with this laterite, the blocks being hollowed out and closely fitting into each other.

13. It will readily be allowed, after examination of these specimens, that the compact material forming the trap No. 1 takes up less space than the same material after its decomposition into clay and re-decomposition into laterite. Considerable expansion must take place, and heat and gas is probably evolved, and the cracked appearance of all hill-tops capped with this rock is thus easily accounted for.

* If trap be an overlying rock, and trap passes into laterite, it is not difficult to conceive how laterite may overlie a "non-trappean rock."—ED.

14. The effect of this expansion is remarkable in this part of the country and bids fair to alter very materially its geography. The rivers are rapidly filling up. Islands are appearing, some even cultivable in situations where, to my own personal knowledge, only eight or nine years since there was sufficient water for boat navigation.

15. On the banks of the streams and rivers more and more ground is annually reclaimed from the tide and brought under cultivation, and revenue is thus on the increase; whilst on the other hand the admirably constructed bunder and quay of Wagotana will probably in a few years be unapproachable by water.

16. This change is not confined to this river, but its neighbour, which sustains the traffic of the city of Rajapoor, is becoming less navigable every year. Formerly country craft could at high-water discharge their cargoes close to the crowded markets of the city, but a transfer to small boats is now necessary.

17. Although a portion of the same trappean range, Kolhapoor, above the Ghâts, is not lateritic. In the month of September in this year the rains had disappeared from this part of the country, but upon getting to the laterite I found there was still a steady monsoon. This I attributed to difference of level, but to my surprise, when returning along the laterite to Belgaum, I carried the rain and clouds with me into that station, which is also lateritic. This is, I believe, always the case; the monsoon invariably continues for a longer period in this region, and suggests the idea of some connexion between these observed phenomena.

18. Does this enormous chemical action going on in the lateritic country exercise an attractive influence, or is the plentiful supply of rain the cause of the lateritic action. I am inclined to the latter opinion. The surface in the neighbourhood of the finest quarries for laterite is generally cracked and full of holes, so that water readily percolates through the coating. The very extraordinary changes which trap thus undergoes are rendered peculiarly striking during the monsoon. Trap is of course from its structure incapable of supporting vegetation, whereas upon laterite considerable crops of grass and singularly beautiful flowers are produced.

19. My object will be accomplished if I have succeeded in showing water to be necessary in this transition; that the laterite now observed capping mountains must have been formed previous to elevation; and that this singular decomposition is now in full activity and effecting important changes over a considerable area in Western India.

ART. XVIII.—*Abstract of the Proceedings of the Society for the Years* 1853-54, 1854-55, *and* 1855-56.

## MEMBERS ELECTED,

FROM THE 28TH NOV. 1853 TO THE 27TH NOV. 1854.

W. F. Hunter, Esq.
B. H. Ellis, Esq., C. S.
W. P. Adam, Esq.
R. A. Dallas, Esq., LL.D.
J. Fleming, Esq.
Rev. F. W. Lindstedt.
Dadabhai Naorozji, Esq.
Lieutenant W. F. Burton.
E. I. Howard, Esq.
J. K. Malcolmson, Esq.
Muncherjee Merwanjee, Esq.
James Erskine, Esq., C. S.
Mirza Áli Jan, Esq.
S. Carvalho, Esq.

FROM THE 27TH NOV. 1854 TO THE 26TH NOV. 1855.

H. Hebbert, Esq., C. S.
James Landon, Esq.
R. T. Reid, Esq., LL.D.
J. H. Standen, Esq.
R. Leech, Esq.
S. D. Sassoon, Esq.
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| NOTES on the Manufacture of Salt in the Tumlook Agency; Report on the Coal Mines of Lakodong in the Tinteah Hills; and Memorandum of the Results of an Examination of Gold-dust and Gold from Shurj-Groveen ..... | Govt. of India. |
| ——— on the Rock-cut Temples and Rock-cut Palaces near Ellora ..... | The Author. |
| OBSERVATIONS, Magnetical and Meteorological, made at the HonorableEast India Company's Observatory, Bombay, in the year 1853, under the superintendence of Lieut. E. Fergusson, I. N..... | Govt. of Bombay. |
| OFFICIAL Correspondence relative to the Assessment of the Omerkote and Narra Districts in Sindh ..... | ——— |
| O'SHAUGHNESSY (W. B.), Report on the Electric Telegraph between Calcutta and Kedgeree ..... | Govt. of India. |
| PAPERS of 1853 and 1854 on the Damoodah Embankments, &c ..... | ——— |
| ——— relating to the Establishment of the Presidency College of Bengal, for 1854.... | ——— |

| | DONORS. |
|---|---|
| PAPERS relating to the Examination held at the Elphinstone College Institution, Bombay, December 1855 ..... | [Instruction. Director of Public |
| ——— relating to the Examination held at the Poona College, December 1855 ..... | ——— |
| ——— relating to the proposed Canal between Ooltdangah and Dholppa, and a direct water communication between the Ganges and Calcutta ..... | Govt. of India. |
| ——— relating to a project for Wet and Dry Docks in the Harbour of Bombay ..... | Govt. of Bombay. |
| PRATT (E.), Memorandum by, on Municipal Conservancy in the Districts of the Bombay Presidency, Sindh, and Sattara ..... | ——— |
| RAFN (Af. C. C.), Nordbaernes Torbindelser Med Osten ..... | The Society. |
| ——— Remarks on a Danish Runic Stone of the eleventh Century found in the central part of London. 1854 ..... | ——— |
| REPORT, Annual, of the Grant Medical College, Bombay, tenth year, Session 1855-56, (2 copies) ..... | [pal. The Acting Princi- |
| ——— by the Collector of Kurrachee on the Hilly region forming the Western part of that Collectorate ..... | Govt. of Bombay. |
| ——— of Crime, and Result of the Administration of Criminal Justice in the Bombay Presidency, for the year 1854-55 ..... | ——— |
| ——— of Education in Sindh, forwarded March 1856..... | [Instruction. Director of Public |
| ——— of the Civil Judicial Administration of the Bombay Presidency, for the years 1854 and 1855..... | Govt. of Bombay. |
| ——— of the Juvenile Improvement Library .. | The Committee. |
| ——— of the Census taken on the 1st January 1855 of the Population of the Punjab Territories; Papers connected with the Administration of Mysore, &c..... | Govt. of India. |
| ——— on Vaccination throughout the Bombay Presidency and Sindh, for 1854-55..... | Medical Board. |

| | DONORS. |
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| REPORT on the Political States S. W. Frontier Agency and the wild Tribes bordering on the south frontier of Chittagong ..... | Govt. of India. |
| RICKETTS (H.), papers by, relating to the South-west Frontier, comprising Reports on Purulia, &c..... | ——— |
| REVARA (J. H. da Cunha), Catalogo dos Manuscriptos da Bibliotheca publica Eborense, Tome I. ..... | The Author. |
| ——— (J.), Descriptive account of a voyage from Lisbon to India ..... | ——— |
| SAGA Jatwardar Konungs Hins Helga, &c. 1852. | The Society. |
| SCHLAGINTWEIT (Messrs.), Report by, upon the proceedings of the Magnetical Survey of India, and of the Researches connected with it in the Himalaya Mountains, from April to October 1855 ..... | Govt. of India. |
| SHORT (J.), Topographical Report by, of the Political Districts of Raigurh, Surungurh, &c. | ——— |
| SOCIETE de la Geographie de Paris, Balletin de, Tome XI. Nos. 61 and 62 for January and February, 4e Serie; Nos. 63, 64, 65, and 66 of Tome XI..... | The Society. |
| SOCIETY, Asiatic, of Bengal, Journal of, No. 7 for 1855 and Nos. 1 to 4 for 1856..... | ——— |
| ——— Bombay, Geographical, Transactions of, from Dec. 1854 to March 1856. Vol. XII. | ——— |
| ——— Royal Asiatic, of Great Britain and Ireland, Journal of, Part II. of Vol. XVI. 1856. | ——— |
| ——— Royal Astronomical, proceedings of, No. 9 of Vol. XV.; No. 1 of Vol. XVI.; No. 3 of Vol. XVI. for January 1856; No. 4 of Vol. XVI. for February 1856, with a List of the Fellows of the R. A. Society; No. 5 of Vol. XVI.; No. 7, May 1856; No. 8 of Vol. XVI..... | ——— |
| ——— Royal, proceedings of, Nos. 14 and 15 of Vol. VII. for 1855; Nos. 18, 19, and 20 of Vol. VIII. for 1856; No. 21 of Vol. VIII.; No. 22 of Vol. VIII. for 1856..... | ——— |

| | Donors. |
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| Society, Students' Literary and Scientific, Bombay, proceedings of, for the years 1854, 1855, and 1856 | The Society. |
| Stack (Captain G.), Dictionary by, Sindhi and English | Govt. of Bombay. |
| Strachey (Captain H.), Physical Geography of Western Tibet. 8vo. 1854 | ——— |
| Supplement to Selections of the Government of India No. VIII.;—Papers relating to the Forests and Iron Mines in Kumaon | Govt. of India. |
| Sykes (Colonel W. H.), Address delivered by, at the ceremony of his Installation as the Lord Rector of Marischal College and University, Aberdeen. 1854 | The Author. |
| ——— Statistics by, of Nice, Maritime. 1855 | ——— |
| Tassy (M. G. de), Les Auteurs Hindustanis et leurs Ouvrages. 1855 | ——— |
| ——— La Rhétorique des Nations Musulmanes. 1848 | ——— |
| Watson (J. F.), on the Sanitary applications of Charcoal, &c. and on Ventilation (2 copies). | Medical Board. |
| Weber (Dr. A.), Indische Studien Beitrage für die Kunde des Indischen Alterthums. Dritten Bandes, Zweites und Drittes Heft | The Author. |
| Wilson (Rev. J., DD.), History of the suppression of Infanticide in Western India | ——— |
| ——— Six Schools of Indian Philosophy | ——— |
| Young (R.), Book of the Precepts, or the Affirmative and Prohibitive Precepts, compiled by Rabbi Mozes Maimonides, &c. | ——— |
| ——— Hexaglot Pentateuch, or the Five Books of Moses, in the original Hebrew | ——— |
| ——— Rabbinical Vocabulary, with lists of Abbreviations and Analysis of the Grammar | ——— |
| ——— Polyglot Reading Book, containing Chaldee portions of Daniel and Ezra, with corresponding Hebrew, &c. (2 copies) | ——— |
| ——— Root-Book; on the principal Roots in the Hebrew Scriptures of the Old Testament in Hebrew, &c. | ——— |

| | DONORS. |
|---|---|
| YOUNG's Shorter Catechism, agreed upon by the Assembly of Divines at Westminster, in French, Italian, &c. | The Author. |
| ——— Syriac version | ——— |
| ——— Song of a Finlandian Country Girl, in the original Finish, with literal Translations into Hebrew, &c. | ——— |
| ZEITSCHRIFT der Deutschen Morgenlandischen Gesellschaft. Herausgegeben von den Geschaftsfuhrern. Zehnter Band 1st, 2nd, and 3rd Heft | The Society. |

## FOR THE MUSEUM.

FROM THE 28TH NOV. 1853 TO THE 27TH NOV. 1854.

| | |
|---|---|
| Albatross, skin of, from the Cape of Good Hope | P.D. Setkhan, Esq. |
| Ampullaria, large specimens of, from a marsh midway between Ahmedabad and Rajcote, close to the Tank of Sholapoor | Major H. Aston. |
| Argillaceous Sandstone, specimens of, white and red, from the neighbourhood of Nagpoor; 35 pieces, bearing impressions of plants, chiefly ferns; 11 of layers of Estheria; 4 of worm-tracks; and 1 of a jaw of a fish | Rev. S. Hislop. |
| Antimony, specimen of, from Borneo | Major L. Jacob. |
| Bali-Literature, specimen of, written on Palmyra leaf | ——— |
| Carapace of a young turtle *(Chelonia imbricata)* covered with the shell, from Macassar | ——— |
| Coal (brown), specimens of, mixed with Pyrites, from Whaghodur, about 12 miles from Kurrachee | G. Elander, Esq. |
| ——— specimen of, from Burdwan | J. Ritchie, Esq. |
| Coins, copper, (3) found in the bed of the Nerbudda close to Burman Ghât. Two are circular, about ½ inch in diameter, and stamped | |

| | Donors. |
|---|---|
| on one side only with a leaf surrounded by a circle of dots; the third, about ½ inch square, bearing a trident on one side, with an impression on the other, which is too indistinct for description..... | Capt.W.T.Nicolls. |
| Coral-tree (*Melitœa ochracea*) from Singapore.. | Major L. Jacob. |
| Cornelians and sea-shells, chips of, from sites of deserted towns in the Desert near Jacobabad. | H.B.E.Frere,Esq. |
| Crocodile (extinct species), anterior part of upper jaw of, fossilized, from near Toat in the valley of the Bharan (Sindh); measuring 10½ inches from the tip of the snout to the posterior part of the transverse suture of the palate; width of jaw at this part 7½ inches, including the external borders of the alveolar processes; two holes for the lower teeth close to the snout 1½ inch each in diameter; diameter of the second tooth back, which is the largest, 1⅜ inch; nasal aperture 6 inches long and 3½ broad in its widest part. The sandstone matrix in which this fossil was imbedded closely approaches that imbedding the fossil-bones of the Sewalik Hills, and also that imbedding the bones of Perim Island opposite the Nerbudda ..... | |
| Fibre and Gutta Percha, specimens of, from the Mudar or Milk-bush of the Punjab ..... | [I. N. Lieut.H. Grounds, |
| Fossil-wood, shells, bones, &c. from the neighbourhood of Saugor, in Central India ..... | Capt.W.T.Nicolls. |
| ——— shells, specimens of, from ditto, found in the Intertrappean Lacustrine formation; and from the bone conglomerate at Burman Ghât on the Nerbudda..... | |
| Galena, carbonate of lead, heavy-spar, and green carbonate of copper, specimens of, from the mines near Ajmeer..... | Maj. G. Fulljames. |
| ——— Ditto ditto from Chittore..... | Dr. Collier. |
| ——— and Pyrites from the Lead-mines near Ajmeer..... | |
| Hog, wild, lower jaw of, with tusks, from Borneo. | Major L. Jacob. |

| | DONORS. |
|---|---|
| Iron-ore, specimens of rich, black, magnetic, from Travancore | Maj. Genl. Cullen. |
| ——— from the Keranch range of hills in the centre of the Jetch Doab | [I. N. Lieut. H. Grounds, |
| ——— vessel, shallow, round, one foot wide, with ears or handles; also pieces of pottery; dug out of a Scythian Circle at Takalgat, 20 miles S. of Nagpoor | Rev. S. Hislop. |
| Kunkur (concretionary limestone), specimens of, from the recent Blue Clay on the Malabar Coast | Maj. Genl. Cullen. |
| Laterite and Basalt, specimens of, illustrative of the Geological formation of the Hill of Punalla, situated about 10 miles from Kolapoor | Dr. Broughton. |
| Limestone, white metamorphic, large granular, specimen of, from Ceylon | Dr. A. H. Leith. |
| ——— nummulitic, and blue shale, specimens of, with fossils from the nummulitic strata of Sindh, collected by C. J. Stewart, Esq., Deputy Collector of Sehwan, during his survey of the Khelat frontier of Sindh | H.B.E. Frere, Esq. |
| Madrepora corymbosa, a large and beautiful specimen of (upwards of 3 feet in diameter), from the northern end of the Cheriapani Reef, called by Horsburgh "Byramgore," the Northernmost, but one, of the Lacadive Islands | Lieut. Selby, I. N. |
| Manis pentadactyla, skin of, from Rutnagherry | Dr. de Crespigny. |
| Plate, Copper (1), large, and Bricks (2) from Wullee, formerly called Bhimlapoor and afterwards Wulbapura, near Bownugger | [C. S. W. E. Frere, Esq., |
| ——— (1), small, found near Barungaon in Guzerat | |
| Relics, disinterred by A. F. Bellasis, Esq., from the site of the ancient city of Braminabad in Sindh; consisting of fragments of cornelian, agate, copper ore, lapis lazuli, pottery, earthen-ware; glass of white, blue, and | |

| | Donors. |
|---|---|
| green colors; beads of cornelian, agate, ruby, lapis lazuli; marbles; bangles made out of sections of large sea-shells; cowries; copper nails; and copper coins of different sizes | [C. S. W. E. Frere, Esq., |
| Relics, Corundum, cornelian chips, talc, beads of turquoise and cornelian, marbles, blue and uncoloured glass, fragments of copper and manufactures in brass, copper coins, pottery, tiles, charcoal, bones, shells, &c. | A. F. Bellasis, Esq. |
| Relief des Monte-Rosa und Seunter ungebungen | A. Schlagintweit. |
| Rock-specimens (15) from the middle of the Pal Ghat, taken from four places, distant from each other about ten miles east and west, all consisting of gneiss with black mica | Maj. Genl. Cullen. |
| ——— (27), consisting of pegmatite, white talciferous granular limestone, steatite of various kinds, rich iron-ore, and old sandstone conglomerate, from the neighbourhood of Nagpoor | Rev. S. Hislop. |
| ——— (60), consisting of white limestone charged with *Alveolina* and *Cyclolina*, smoky-grey ditto with similarly coloured argillaceous strata and clay-slate, coal, &c. from the Bolan Pass. Some of the specimens of limestone are encrinitic | Dr. A. H. Leith. |
| ——— consisting of gneiss, bearing garnet and cinnamon stone; black mica with garnet; graphite copper-ore (green carbonate); of coarse white granular limestone bearing graphite; of red and green garnet, pargasite, and idiocrase; of fine white decomposing pegmatite (kaolin); of white laterite. Of Tertiary Pliocene (?) concretionary travertin (old kunkur) bearing *Helix hortensis* (?) in a white semi-consolidated state. Of Tertiary Pliocene (?) rock composed of consolidated, calcareous, sandy beds raised above the sea | |

DONORS.

and resting on gneiss. Of Miocene (?) limestone; limestone abounding in cavities from which the carbonate of lime belonging to the shells they contained has been dissolved out. Coarse bluish miocene orbitoliferous limestone underlying the beds of lignite at Quilon. Laterite. Variegated sands; sandy clays; and beds of lignite; carboniferous clays; white, friable rocks like decomposing gneiss or kaolin, stated to contain organic remains (corals).—This interesting and valuable collection illustrates the rocks between Tinnevelly and Travancore, passing round the extremity of the mountains at Cape Comorin to the Westward, then up the coast as far as Cuddaputnum, inland to Oodeghery, and lastly along the high road to Trivandrum..... Maj. Genl. Cullen.

Shale, Carboniferous, (200) specimens of, from Newcastle, bearing impressions of plants, illustrative of the vegetation of the Coal Period.—A very valuable and extensive collection ..... Dr. A. H. Leith.

Shells, recent, a collection of, from Malacca .... Rev. Lindstedt.

Shorl-granite, specimen of, from the neighbourhood of Ajmeer.—The mica and shorl in very large crystals ..... Dr. Collier.

Sulphur, specimen of, from the Island of Java..... [C.B. Lt. Col. Whitlie,

Whale, dorsal vertebræ of (3) ..... [LL.D. R.S. Sinclair, Esq.,

Wooden figure of a Bali-god from the temple of Kasumba..... Major L. Jacob.

FROM THE 27TH NOV. 1854 TO THE 26TH NOV. 1855.

Coins (Copper) Indo-Scythian (31), from a large collection in the possession of Major Hollings, Deputy Commissioner of the Sholapoor District in the Punjab ..... [I. N. Lieut. H. Grounds,

| | Donors. |
|---|---|
| Coins, Indo-Scythic, a book of impressions of, taken by means of the Muddar Gutta Percha. | [I. N. Lieut. H. Grounds, |
| Coin, Copper (1), Hindu, found in the mud of a tank at Poorundhur ..... | Mr. Sargon. |
| Dentritic Sandstone, specimens of, from the Southern Muratha Country; also of Steatite of a hard crystalline structure, dark-green colour, from Akern, near Sawunt Warree, and Ramghur, on the Phonda Ghât ..... | Capt. A. de Lisle. |
| Fibre, specimen of, from the Muddar Bush, and different kinds of cotton, with cloth and cord made from the former, grown in the Punjab. | [I. N. Lieut. H. Grounds, |
| Fossils, specimens of, from the tract which lies between the highest mountains behind Berbera and the sea. In this collection there are Terebratulæ, Pholodonnya, Gryphœa, and Belemnites of the Jurassic age, like those of Cutch; also several shells and corals from the Tertiary Formation, in all amounting to upwards of 150 specimens ..... | Capt. R. F. Burton. |
| ——— from the Nummulitic beds and other Tertiary deposits; together with pebbles of Hornblende, Syenite, and Limestone rocks from the Cabul River ..... | [C. S. H.B.E.Frere, Esq., |
| ——— from the older stratified rocks of the Punjab, also from the Eocene formation there. | Major Hollings. |
| Fragments (15), in *Terra Cotta*, of ornamental parts of a Buddhist Temple, found at the southern extremity of the Hyderabad range of Hills in Sindh. These remains are precisely of the same kind as those forwarded from the ruined Temple near Jerruck..... | [C. S. H.B.E.Frere, Esq., |
| Geological specimens of a formation, 25 miles south of Trivandrum in Travancore, composed of the detritus of Gneiss, containing much Plumbago, also marine fossils ..... | Maj. Genl. Cullen. |
| ——— specimens and fossils illustrative of the Geology of the tract which lies between the highest mountains behind Berbera and the sea ..... | Capt. R. F. Burton. |

| | DONORS. |
|---|---|
| Geological specimens of Syenite, Trapp, white chrystalline Limestone, and Sandstone, also Fossils, from Nuggur Parker, on the edge of the Runn, and from the Thur or Great Desert. | [C. S. H.B.E.Frere,Esq., |
| Gums and Rope-fibre, specimens of, collected at Berbera ..... | Lieut. Hearne. |
| Hair-Ball, specimen of, from the stomach of a Sheep, in which there were eleven..... | Rev. Dr. Wilson. |
| Horns (pair, attached to the frontal bone) of the Solitary Bull, inhabiting the Western Ghâts of India ..... | Capt. Bainbrigge. |
| Marbles, handsome collection of specimens of polished, and other decorative stones, together with rich red hæmatite in quartz rock, and a specimen of heavy spar..... | Major Hollings. |
| Nostoc, dried, specimens of, from Boordike in upper Sindh..... | [C. S. H.B.E.Frere,Esq., |
| Rupee (square) of the Emperor Akbar ..... | [C. S. H. Hebbert, Esq., |
| Slabs (2), bearing inscriptions in Persian and Murathee, from the Fort of Galna in Khandesh. | [son, Esq.,C. S. A. St.J. Richard- |

FROM THE 26TH NOV. 1855 TO THE 24TH NOV. 1856.

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| Coins, Silver (4), which were selected from a few of the same kind found at Kusba Thair, in the district of Nuldroog..... | Capt. M. Taylor. |
| Geological specimens, a collection of (28), from the Oolitic (?) Series, bearing impressions of Ferns, &c. in Coal-Shale, from Barkoi Amret, 90 miles NNW. of Nagpore ..... | Rev. S. Hislop. |
| ——— ditto, bearing impressions of *Phyllotheca* in foliage, in Sandstone, from Silewadi and Bharatwada; and Worm-tracks from Korhadi in the vicinity of Nagpore..... | ——— |
| ——— specimens of Porphyry from the same Province; and of Voysey's so-called fossil oyster shell bearing limestone, at Droog.... | ——— |
| Gutta Percha, specimens of, and of the leaf, flower, seed, and bark of the Panchachathee tree from which it is obtained. Discover- | |

| | DONORS. |
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| ed by Major Genl. Cullen, along the base of the Ghâts between Trivandrum and the town of Paulee in the Cochin Country ..... | Maj. Genl. Cullen. |
| Laterite, specimens (4) of, from the Island of Salsette..... | Dr. Buist. |
| Lignite, specimens of mineral resin, pyrites, &c. from sedimentary strata lying under the Laterite at Rutnagherry..... | Dr. de Crespigny. |
| Medal, Bronze, $2\frac{1}{4}$ inches in diameter, bearing on the *obverse* the head of the donor with the words "Richard Sainthill, of Topsham, Devonshire, Numismatist, Bombay, January 28th, 1778—1855, L. C. Wyon, ft."; and on the *reverse* a group of figures, round which are the words, "Irradiating the present—Restoring the past—Numismata—L. C. W." | R. Sainthill, Esq., through W. E. Frere, Esq., C. S. |
| Nautilus Deluci, fragments of, from Sindh .... | A. F. Bellasis, Esq. |
| Photograph of a design for an Inlet Tower for the Water-works of Vehar, now in course of construction by the Government, for supplying Bombay with water ..... | H. Conybeare, Esq. |
| Plaster-cast of a Bactrian Silver Coin..... | James Gibbs, Esq., C. S., through W.E.Frere, Esq. |
| Red earthen spheroidal balls, specimens of, which were found by Dr. Burn, Mr. Lyon, and Dr. Wilson, in a quarry of the red ferruginous clay at Mahableshwur, from six to twelve feet from the surface ..... | Dr. Wilson. |
| Rock, Magnetic Granite, from the top of an insulated hill 800 ft. high near Trivandrum.—See an account of its examination in detail, Proceedings of the Trivandrum Museum Society, 21st December 1855, by J. A. Brown, Esq., pp. 4 and 89 ..... | Maj. Genl. Cullen. |
| Series (A) of specimens, numbered 1—12, of Granite, Gneiss, and Laterite, the latter never more than 200 yards from the two former respectively. Nos. 1 to 4 from Tallapilly, a district forming the north boundary of the | |

| | DONORS. |
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| Cochin State; Nos. 5 and 6 from Trichoor, a central district; Nos. 7 to 9 from Moogoondapoorum, a SW. district; Nos. 10 to 12 from Cannanore, the most southerly district, Capital Tripontary..... | General Cullen. |
| Slab (1), bearing Persian inscriptions, taken out of the old castle-walls of Galwa, 20 miles SW. of Khandesh ..... | [son, Esq. A. St.J. Richard- |
| Specimen of Flying Squid (*Ouychoteuthis angulata*), and Sucking Fish (*Echeniss remora*) | Dr. Johnstone. |

## ORIGINAL COMMUNICATIONS.

FROM THE 28TH NOV. 1853 TO THE 27TH NOV. 1854.

| | COMMUNICATED BY |
|---|---|
| Bellasis, (A. F., Esq.), Observations by, on the ruined city of Brahminabad in Sindh.—20*th April* (see p. 413) ..... | B. H. Ellis, Esq. |
| ——— Ground plan and elevation of house excavated among the ruins of ditto, with sketches of the pottery found there.—12*th October*.. | The Author. |
| Broughton, (Dr. F.), Description of an earthquake in the Kolhapoor Country in July 1853, with observations upon the Geological changes produced by it.—21*st Sept.* (p. 677) | ——— |
| Carter, (H. J., Esq.), On Zoosperms in *Spongilla*.—24*th Aug.* (Ann. & Mag. Nat. Hist. vol. xiv.) ..... | ——— |
| Dhunjeebhoy Framjee, Esq., Rudiments of Pehlvi Grammar by.—23*rd Feb.* (Published by the Author) ..... | ——— |
| Ellis, (B. H., Esq.), Memorandum of the Mud Craters in Lus Beyla, visited in August 1853.—27*th July* (p. 676)..... | H.B.E. Frere, Esq. |
| Fac-simile Transcript and Translation of a Copper-plate grant dug up at Veesapoor.—24*th August* (Recorded)..... | Govt. of Bombay. |
| Jones, (Comr. F.), Reply to the Rev. Dr. Wilson's inquiries respecting Sepulchral and other remains from the plains of Gerarah, for- | |

| | COMMUNICATED BY |
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| warded to the Government of Bombay.—*23rd February* (p. 672) ..... | Govt. of Bombay. |
| Nicolls, (Capt. W. T.), Memorandum on Fossil-sites about Saugor in Central India.—*22nd December* (p. 671) ..... | The Author. |
| Peyler, (W. E., Esq.), Extracts from a report by, on the proposed line of Road through the Valley of the Hubb from Kurrachee to Keneree.—*19th January* (Recorded) ..... | H.B.E. Frere, Esq. |
| Stevenson, (Rev. J., D.D.), Parting visit to the Sahyadri Caves by.—*20th April* (p. 426) .. | The Author. |
| West, (A. A., Esq.), Description of the Caves and Cave-Temples in the Sattara Districts by.—*12th October* (p. 673) ..... | Rev. Dr. Wilson. |


FROM THE 27TH NOV. 1854 TO THE 26TH NOV. 1855.


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|---|---|
| Carter, (H. J., Esq.), on the Development of Gonidia (?) from the Cell-contents of the Characeæ, and on the Circulatory Movement of the Protoplasm.—*22nd February* (p. 521) | The Author. |
| Friederich, (R. H. Th., Esq.), Translations with Fac-Simile of a Rock Inscription in Sumatra by.—*11th October* (p. 691)..... | Col. LeG. Jacob. |
| ——— of an Inscription from a Temple in Java by.—*Ditto* (p. 691) ..... | ——— |
| Impey, (Dr.), Description of the Caves of Bagh in Rath (with drawings) by.—*28th December* (p. 543) ..... | The Author. |
| Jacob, (Colonel LeG.), Translation of a Copper-plate inscription, dated Shuk 910, in the possession of a Jain at Khareputan (presented by him to the Society, April 1851) in which reference is made to the founding of Bali, &c.—*11th October* (p. 691) ..... | ——— |
| ——— (Colonel LeG.), a few Observations on ancient Coins found in Kutch.—*Ditto* (p. 691). | ——— |
| Kirby, (Captain J. H.), Description of Ruins found in the bed of the Narra Supply-Channel.—*Ditto* (p. 692) ..... | [C. S. H.B.E. Frere, Esq., |

| | COMMUNICATED BY |
|---|---|
| Narrain Wiswanath, Memorandum by, of Omerkote and its Soda Princes.—14*th June* (p. 538) | H.B.E.Frere,Esq., [C. S. |
| Preedy, (Capt. W. H.), Further accounts of the Ruins of Brahminabad in Sindh, by.—*Ditto.* (Recorded) ..... | ——— |
| ——— Notice of a number of old Wells on the ridge of a rocky ground extending North-East of Bamboora (with a Sketch), by.—25*th January* (Recorded) ..... | ——— |
| Schlagintweit (the Messrs.), Report on Meteorological observations made during a voyage from Southampton to Bombay, between the 20th of September and the 26th October 1854.—28*th Dec.* (See Beng. As. Jl.).. | The Author. |
| Trumpp, (Dr.), Essay on the Sindhian Alphabets.—28*th December* (p. 685) ..... | Rev. Dr. Wilson. |
| Wilson, (Rev. Dr. J.), Review of the present state of Oriental, Physical, and Antiquarian Research in the West of India.—23*rd November* (p. 497) ..... | The Author. |

FROM THE 26TH NOV. 1855 TO THE 24TH NOV. 1856.

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|---|---|
| Buist (G., LL.D.), Observations by, on the Transformation of Trap into Laterite.—13*th March* (p. 700) ..... | The Author. |
| Carter, (H. J., Esq.), Notes by, on Freshwater Infusoria in the Island of Bombay. No. 1, Organization.—10*th January* (p. 429) .... | ——— |
| ——— On the Development of the Root-Cell and its Nucleus in *Chara verticillata*, Roxb.—10*th July* (p. 521) ..... | ——— |
| ——— On the Transformation of Vegetable Protoplasm into *Actinophrys* (p. 592)—13*th November*..... | ——— |
| Frere (H. B. E., Esq.), Note by, on the Luminous Water in the Sea between Bombay and Aden.—28*th February* (p. 698)..... | ——— |
| Spiegel (Profr.), Extract of a letter from, to the Rev. J. Murray Mitchell.—14*th August* (p. 703) ..... | Rev. J. M. Mitchell. |

# PROCEEDINGS, OFFICIAL, LITERARY, AND SCIENTIFIC.

FROM THE 28TH NOV. 1853 TO THE 27TH NOV. 1854.

*Memorandum on Fossil Sites near Saugor, in Central India.* By Captain W. T. Nicolls, Madras Army.—This interesting communication is accompanied by a sketch map of the neighbourhood of Saugor, indicating the position of the fossil-sites known to Captain Nicolls, also a descriptive list of the last valuable collection which Captain Nicolls presented to the Society, with references to the localities in the sketch map from which they respectively came.

The communication itself contains many valuable observations with respect to the relative position of the basaltic hills, and shelly limestone lacustrine deposits of India, in the neighbourhood of Saugor. The latter are sometimes merely overlaid by the regur, while the Oolitic (?) Sandstone hills being as numerous as the trappean ones, in this part of the country, and no other formation present, it would seem as though the lacustrine formation must rest on the sandstone where it has not been separated from it by the trap. Captain Nicolls' observations tend to confirm also Dr. Spilsbury's section of basalt overlying siliceous limestone and limestone conglomerate with fragments of bones, 1½ mile from Jubbulpore, (over which Prinsep threw a conjectural doubt), and which limestone, there, rests on "friable granitic sandstone."

With reference to the brown-coal above mentioned,* Mr. Elander states that it is to be found in many places in the Kurrachee Collectorate. It is probably of the upper Eocene or lower Miocene age, and connected with the blue-clay underlying the sand and conglomerates in the neighbourhood of Kurrachee.—*22nd December* 1853.

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The letter from the Rev. Mr. Hislop announces the despatch of another box of rock-specimens, minerals, and fossils for the Society from the neighbourhood of Nagpur. In his letter also is the following paragraph respecting ancient sepulchral remains, similar to those described by Captain Meadows Taylor, (Vol. IV. p. 380 of the Society's Journal) :—

"At the top of the box there is an iron vessel like a frying-pan, but when complete, provided on each side with an ear or handle. Several years ago I dug it out of a Scythian stone-circle, at Takalghat, 20

* Page 660.

miles S. of Nagpur. When it was brought to light, at the height of about half an inch from the bottom it was covered over with fragments of pottery fitted to each other so as to form a kind of mosaic work, evidently to protect the ashes which were deposited in it. In the same cairn were found a spear-head, a piece of iron like a large knife or hatchet, nails, &c. At Takalghat there is a wide field for the antiquary. Indeed the country all round abounds in Scythian remains, but it would require a person with much leisure for their investigation. I am acquainted with about twenty localities where there are circles, and eight villages where there are Kistvaens in this district."

Of the recent fossil discoveries of the Rev. Messrs. Hislop and Hunter, the former states:—"The number of our fossils has not greatly increased of late. But since I wrote to you we have found some more animal remains in the sandstone. The jaw of a fish (?) mentioned above is an example. Such remains are generally accompanied by fish scales of the ganoid order, and hence I am inclined to think them remains of fish rather than of saurians. But we have got one very fine saurian head entire; the shape is that of an equilateral triangle, the neck constituting a base of about 5 inches. Like the *Labyrinthodon* and *Archegosaurus* it is covered with radiating grooved bones or scutes, but the distance between the orbit of the eye and the snout is less in proportion than in either of these. I have also fallen in with a pretty fruit, very much like a diminutive cocoanut. Those new discoveries are from Mangali, 60 miles south of Nagpur, where the sandstone is argillaceous and of deep red colour."

Commander Jones, in reply to certain inquiries by Dr. Wilson forwarded to him by Government, gives an account of the position in which the funeral remains forwarded by him last year were found at Gehrarah, and his own estimate of their peculiarities and antiquity. The place at which they were got, he considers the site of the ancient Kilwatha. The coffin or sarcophagus and sepulchral cover, he is of opinion have no connexion either with Mahommedans or Christians; but may belong to the earlier Greek era of Mesopotamia. Their accompaniments, he thinks, may have been the utensils supposed to be necessary for the dead interred in them on entering Hades and encountering Charon.

Dr. Wilson, with reference to this reply of Commander Jones, observed, that though, in the first instance, he had stated certain difficulties, and made certain inquiries about these remains, he is perfectly satisfied about their antiquity, as he had shown at the conclusion of

his second Memoir on the Antiquities of Western India, &c., in the Society's Journal for last year (Vol. IV. p. 372), to which he begged to refer Commander Jones for further information about the view which he had ultimately taken of them.—23*rd February* 1854.

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In a note from Mr. A. Young, which is enclosed in Mr. Frere's, accompanying the crocodilian fossil abovementioned,* the former states that the place where such fossils, with mammalian remains also, are found near Sehwan, is about five or six miles west of this town, in a direct line between Bajar and the Lukkee Pass. They are imbedded in a consolidated sandy deposit like that on which Sehwan is built, but most are lying loose in the dry beds of small water-courses. It is difficult (Mr. Young states) to say from whence the Sehwan sandstone could have come; the grit is but slightly calcareous, and the red does not effervesce with acid. Mud eruptions containing gypseous beds were observed in the neighbourhood of the locality where the bones were found.

Major LeGrand Jacob, who writes from Singapore on the 3rd instant, forwarding the presents abovementioned† from the Rev. Mr. Lindstedt and himself, states, with reference to the Sanskrit inscription which he presented to the Society in 1851, that "the pleasant sea-girt town of Bali" therein mentioned, does not appear to be the Island of Bali in the Eastern Archipelago, as he had thought, but some place in India. Mr. Friederick (Librarian of the Batavian Society) to whom he has given a copy of the inscription, and who has written some excellent articles on Bali (two of which are in the Journal of the Eastern Archipelago), having been sent there expressly by the Dutch Government to inquire into the languages, literature, and religion of the people, has promised to study this inscription and to communicate with the Society respecting it. Major Jacob further adds, that his chief object in writing is to impress upon the Society the importance of Bali and its neighbourhood as promising clues to many of our Indian mysteries; advises that copies of the *Purans* should be given or lent to Mr. Friederick, that he might point out what was new and what acknowledged in Java, as this would throw light on Hindu Chronology; and also suggests, that the Society should, through the assistance of the Batavian Society, obtain copies of the present Bali religious works claiming any degree of antiquity.

* Page 661. † Page 664.

Under the title abovementioned* Dr. Stevenson states, that in his journey to and from Ahmednuggur, he took the opportunity of visiting the caves at Karlen and Junir; the advance of the season and other circumstances prevented his going to the caves of Nassik, though he had no important doubts to solve in them. The object in view was to ascertain how far the lithographed copies of the cave inscriptions lately published by the Society were to be depended on, and whether the change he had ventured to make in some of them were warranted by the originals engraved on the rocks.

After a careful examination and comparison, Dr. Stevenson came to the conclusion that Mr. Brett's fac-similes were in general very exact, and that the reduction of them in the Society's Journal had on the whole been faithfully executed. Also, that where parts of the letters had become obliterated, Mr. Brett had for the most part supplied them with just discrimination.

There were, however, a few exceptions to this, which Dr. Stevenson then enumerated and explained, alluding to the different lithographed copies in which they were to be found; and concluded as fellows:—

"As I may not again have an opportunity of addressing the Society, I embrace the present occasion to express my gratitude to the Members for the favourable reception they have given to my papers on Indian Antiquities. Without the advantages of the Library of the Society however,—the stimulus afforded by the success of my fellow-labourers in this and in other departments, especially the Geological,—and the advantage of such a medium of communication with the public as the Society's Journal furnishes,—it is not likely that my attention would have been directed to such subjects at all, or, if directed, that I should have been able to persevere in their successful prosecution."

Mr. Bellasis observes respecting the ruined town of Brahminabad †—

"The Deputy Collector of Halla and myself visited the ancient and ruined city of Brahminabad, situated on one of the branches of the Narra, called the Jerarí, now dry. The city is enclosed within a fort-wall, well defined and mounted with numerous bastions and towers. These walls are very nearly four miles in circumference measured by a perambulator. Besides Brahminabad, at the distance of one and a half miles is the ruined city of Dolora, and five miles in another direction the ruined city of Jerar Gangra, and between these several cities are the remains of suburbs and villages for miles round.

* "Parting Visit to the Sahyadri Caves," p. 669.

† Page 413.

"Amid the chaos of ruins of brickwork are several open squares and bazars of great extent, and the most prominent object is a tower, also of brickwork, standing isolated on a large head of ruins.

"I selected a heap standing on the verge of the principal bazar for excavation. I had not commenced many minutes before I came upon the edge of a wall; clearing it, I soon came upon a cross wall, and then upon another and another. I had not dug to the depth of two feet before I came upon quantities of human bones, and at that and greater depths bones were so numerous, that it was hardly possible to dig a shovel-full without bringing up particles of bones. As far as I could judge, many were undeniably human bones, and others of cattle and of horses; the human bones were chiefly found in the corners of the rooms and in-doors, as if in days of yore the idea prevailed that there was safety in a corner. Many of the skeletons were in a sufficiently perfect state to enable me to decide whether they were in upright or reclining positions. One in particular I remember finding in a doorway, the man had evidently been rushing out of his house when a huge heap of brick-work crushed him to the ground, where his bones were lying extended full length and the face downwards.

"Besides bones, I found a large quantity of pottery of sorts, much of it of a very superior description to any I see made now-a-days in Sindh (a good deal of the pottery was glazed in colours of great brilliancy); stones for grinding grain; a grain jar, also of pottery, some five feet in depth, and two feet at the mouth, was found sunk in one of the rooms; quantities of cornelian chips, pieces of agate, and balls beautifully turned of ivory, agate, and other stone; coins, chiefly of copper, some few of silver; beads, and ornaments of cornelian in great variety.

"The most curious relic I found was an octagonal piece of what I imagine to be ivory, with inscriptions on each side, similar to the Sanskrit or Devanágarí character; and also a signet with the same character.

"Finding such success during the first day's excavations, I increased the number of excavators from 20 to 70. In the three days I was at Brahminabad I excavated three distinct houses, two on one side and one on the other side of a street running out of the bazar.

"A plan of the excavations, a map of the city and neighbourhood, with a more detailed account of the relics found, I propose to draw out on my return to Hyderabad. I look upon Brahminabad as a wonderfully curious place, and I think the popular account that it was destroyed by an earthquake highly probable."

The Rev. Dr. Wilson laid before the meeting a drawing of an apparently undescribed species of *Gannetta*, which had been caught at Love-grove, and on which he proposed to make some observations on a future occasion.—*20th April* 1854.

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*Memorandum on the Mud-Craters in Lus Beyla, visited in August* 1853. By B. H. Ellis, Esq., Assistant Commissioner in Sindh.—The author's object in this paper on the mud-volcanoes of Lus Beyla, is to record a description of their forms, &c. at the time he visited them, and by comparing this with the descriptions of the late Captain Hart (1839) and Captain Robertson (August 1849), [this Journal, vol. iii. part 2, p. 8] to show the alterations that have taken place in the groups which were visited by all three parties.

Specimens of the mud, sulphur, gypsum, shells, &c. alluded to in the memorandum, were presented to the Society on the 17th November last.

In the group first visited, viz. those called the "Raja Ram Chunder Koops," the diameter of the crater in the highest volcano (which is 57 feet) is within a few inches of that given by Captain Robertson, but the points of ebullition and overflow, instead of being on the southern side, as stated by Captains Hart and Robertson, are now, the former in the NW. part and the latter between the N. and E. points.

Also in the small volcano of this group, the crater, which was almost quiescent at Captain Hart's visit, is now as active as that of its neighbour, and its diameter greater and sides thicker than at that period.

In the next group visited, viz. the *Kamal-i-put*, situated near the sea-shore, there does not appear to be much alteration; Mr. Ellis did not see the fifth crater there, mentioned by Captain Robertson; and the cone described by him as rising in the centre of the crater of the great volcano no longer exists, though traces are present of its having fallen in; while a few feet from it there is another truncated cone, at a depth of twelve feet from the orifice of which is mud in strong ebullition; the orifice of this cone is three feet in diameter.

In the other large volcano of this group, the number of small basins appear to have increased, while the activity of the muddy ebullition has decreased, since the visit of Captain Robertson.

The other groups visited by Captain Robertson, the party had not time to visit.

Mr. Ellis in conclusion states, "I trust that others with greater leisure will be able to visit this interesting locality and add to the scanty amount of information which is now on record regarding it."—*27th July* 1854.

*Description of an Earthquake which took place in the Kolhapoor Country in July* 1853*; with observations upon the Geological changes therewith connected.* By Francis Broughton, Esq., Assistant Surgeon, Bombay Army.—The author states that the hill upon which the fortress of Punalla is situated, about ten miles from Kolhapoor, was shaken by an earthquake on the 14th July 1853. The shock was not very violent and no lives were lost, but the houses and temples of a village in the vicinity were much injured.

After a few observations on the manner in which such convulsions, with the disintegration of the rock, which is at present going on, may increase the arable soil in the Kolhapoor Country, Dr. Broughton goes on to describe the hill of Punalla, which is 975 feet above the plain, and composed of laterite, supported on prismatic pillars of basalt, the columns of which, being of different heights, here and there present narrow ledges, on which are situated villages and cultivation.

On the night of the day mentioned, the inhabitants of one of these villages were "disturbed by a perceptible trembling of the earth, accompanied by a loud hissing noise, as of escaping steam. The shock was thrice repeated, and lasted about two minutes; but the sound continued nearly a quarter of an hour."

"The solid masonry of a substantially constructed temple was cracked through from base to pediment; many buildings fell; and houses were so distorted that the walls opened, and door-frames were crushed or bent from the usual position. The startled sleepers were in some instances hurt by falling stones, and the watchman, whilst proceeding to alarm the Patell or chief Native authority, was astonished by finding his progress opposed by a chasm which crossed the main street of the village. This chasm or fissure was afterwards found to run due east and west, and to be about two and a half to three feet wide, of immense depth, and extended upwards into the hill side, where it was lost at the junction of the laterite with the basalt. Huge masses of earth and enormous boulders were scattered among the trees, which in a great degree protected the village from injury; and here and there a gigantic pillar, broken into fantastic fragments, had fallen over and completely obstructed the road."

The author next alludes to the danger of villages being built on the ledges mentioned, and the means by which the people who at present dwell there might be compelled, without actual force, to withdraw their habitations from such dangerous localities. In conclusion, he also notices the existence of "an ancient and capacious reservoir now in ruins," which is situated in the neighbourhood of the fissure already

described, and through the massive wall of which is a large rent that destroyed the reservoir, and which the author thinks must have been produced by an earthquake like the one mentioned.

Dr. Buist stated that this was the only instance recorded of actual alteration in the earth's surface by earthquake in this part of India, south of the 20th degree of north latitude: that no mention was made of any earthquake south of this degree by Captain Baird Smith in his compilations on the subject, and therefore the circumstance was well worth remembering. He also observed that no shock of an earthquake south of the 18th degree of north latitude had been recorded [Punalla is situated in about 16° 38′ N. L.] The limited nature of the alteration, and the great violence attending it, were also remarkable facts.—*21st September* 1854.

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With reference to Mr. H. B. E. Frere's letter, dated 1st instant, suggesting the desirableness of publishing an abstract of Mr. Bellasis' paper on the ruins of the ancient city of Brahminabad, mentioned among the presents for the Library, the Meeting resolved—that as a small issue of papers printed in this way was sure almost to end in their being altogether lost after a few years, the one in question, or an abstract of it, whichever might be thought most advisable, should, in accordance with Mr. Frere's suggestion, be inserted in the next number of the Society's Journal. (See p. 413, &c.)

*Description of the Caves and Cave-Temples in the Sátárá Districts.* By Arthur A. West, Esq., C. E. Communicated by the Rev. Dr. Wilson, Honorary President of the Society.—Dr. Wilson, on laying Mr. West's paper on the Caves and Cave-Temples of the Sátárá Districts before the Society, remarked that it contained a particular and accurate description of no fewer than ten series of groups of caves in the province to which it refers, which had been all personally visited and surveyed, and, in a few instances, discovered by Mr. West, whose zeal in antiquarian research merited much commendation, more particularly when it is considered that he is an active volunteer in the cause. In these groups there are three *Chaityas*, or temple excavations; ten *Dahgobs*, or depositories of relics; thirteen *Vihars*, or monasteries; fifty-nine large excavations, mostly with adjoining cells; forty-six smaller excavations; and a total of 122 excavations. Of the groups, five are Buddhistical; three Brahminical; and two doubtful. Hindu *Jattras*, or religious fairs, are now annually held at most of them, particularly in the months of April, August, and

October. They are all found in a district about 80 miles in length by from 50 to 60 in breadth. Dr. Wilson mentioned that he believed that a close examination of the *Khoras* and spurs of the Sahyádri range in all portions of the Maráthá Country, especially where there are passes to and from the Konkan, would reveal an equal number of religious excavations. The fact is that their numbers in this part of the country are incredibly great.

Mr. West states that owing to the coarseness of the rock in which these excavations are executed, they present nothing of special interest in an artistic point of view. He characterises them as "wretched specimens of misapplied labour," only interesting in a historical point of view, as illustrating the hold which religious systems now passed or vanishing away had of this part of India. They must, he thinks, have been all plastered internally, principally with mud. Traces of only two inscriptions are to be found at them; and of these probably nothing can be made.

The Buddhist images of the excavations of the West of India, Dr. Wilson added, are of a Hamitic type, the Buddhist priests having chosen this type as illustrative of their "points of beauty." This is not because they had any connection with Africa in the days of old, but perhaps because Shákya Muni, or Buddha himself, belonged to a Hamitic Scythian tribe, that of the *Sacæ*. The earliest immigrations into India which can be traced were of Scythian origin; and such immigrations were of a periodical character for many ages. The non-Sanskrit elements of the vernacular languages of India are principally Scythian, additional light on which would be cast by an examination of Mr. Norris's decipherment and translation of the Scythian cuneiform inscriptions at Behistun, which would reveal some curious coincidences even with the Gujarátí, as in the first personal pronoun *hun*, I, the inflexion for the genitive of nouns, and some nouns in their pure form. Even the Hindu *Kusha* of the Puranas is not, as imagined by some, the secondary *Cush* of Africa, but the primary *Cush* of Gen. ii. 15, encompassed by the Gihon, or Oxus.—12*th October* 1854.

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## ANNIVERSARY MEETING.

The *President* having called for the Report of the Committee of Management for 1853, the *Secretary* read as follows:—

Gentlemen,—During the past year eight Resident and three Non-Resident Members have been elected. There have been 119 books and

pamphlets presented to the Library; fifty donations to the Museum; and thirteen original communications read at the monthly meetings.

To the Library 191 works, consisting of 336 volumes, have been added by purchase; 772 volumes, comprising about an equal number of octavos, quartos, and folios, have been rebound; 60 repaired; and 417 files of old Newspapers have been collated and stitched.

The total number of Periodicals, Newspapers, Army Lists, and Almanacs received by the Society has been 72, viz. 40 Literary and Scientific Periodicals and Journals, of which 6 are presented by the Societies who publish them, in exchange for the Society's Journal; 24 Newspapers, and 8 Calendars, Army Lists, and Almanacs.

Your Committee regret that the Alphabetical Catalogue is but little more advanced than it was last year; at the same time it has been so far completed, that any one well acquainted with Literary and Scientific publications could easily pass it through the Press, and such a person your Committee trusts may soon be found, whose services being remunerated might further insure the publication of this work in a satisfactory manner.

The usual annual number of the Society's Journal has been published, viz. No. XIX.; and, in accordance with the resolution of the Society passed at its Anniversary Meeting held in November 1853, has been distributed to the Members gratuitously.

Amongst the donations of the Museum, your Committee would particularise those of Major General Cullen, Political Resident in Travancore, and Captain W. T. Nicolls, of the 24th Regiment Madras N. I., now at Saugor in Central India, who, in addition to former contributions from their respective localities, have enriched the Museum during the past year with some of the most interesting and valuable collections of fossils and geological specimens that it has ever received.

It is with regret that your Committee find the Secretary's duties so increased, as to oblige him to state, that without assistance he will not be able to carry on the business of the Society, and we therefore, at his suggestion, submit that the old custom of the Society should be resumed and some one requested to take part of those duties as Joint Secretary.

The Auditor's report shows a smaller balance in favour of the Society than that of last year, but for this your Committee were prepared, on account of the reduction of the subscription of Non-Resident Members from Rs. 30 to 15 per annum, and the gratuitous distribution of a copy of the Journal to each of the Members, both Resident and Non-Resident, in lieu of to those only who originally subscribed for it.

Further, the Auditors observe that at present the Society receives no interest for its capital, and that as there is always a considerable sum in hand during the greater part of the year, it would be desirable to transfer this from the present Bank to another, or to a Mercantile House allowing interest on current accounts—a proposition in which your Committee entirely concur, and therefore recommend that it should be carried into effect.

Lastly, your Committee would bring to the notice of the Society the want of room that exists in the Society's Library, which occasions some hundreds of volumes to be placed behind others, where they cannot be seen; also the same want of room in the Museum; disadvantages which of course considerably diminish the use of both these departments: but the funds of the Society being totally inadequate to meet the expense which the alterations and additions necessary to supply these deficiencies would entail, your Committee do not feel prepared to go further than to record these facts for the future consideration of the Society.

The Rev. Dr. Wilson, seconded by T. L. Jenkins, Esq., proposed that the Committee's Report should be accepted, with the best thanks of the Society for their valuable services during the past year, which was unanimously carried.

The Rev. P. Anderson, *Vice-President*, seconded by Colonel Waddington, C.B., *Vice-President*, proposed, in accordance with the Committee's suggestion, that R. S. Sinclair, Esq., A.M., Professor of Mathematics in the Elphinstone Institution, should be appointed Joint Secretary, which was also unanimously carried.

Professor Sinclair having expressed his thanks for the honour conferred on him, stated that he would be happy to assist in the performance of the duties of Secretary to the best of his ability.

The following gentlemen were elected for the Committee of Management, Museum Committee, and Auditors for the ensuing year:—

*Committee of Management.*

| | |
|---|---|
| W. Howard, Esq. | Captain J. G. Forbes. |
| Rev. G. Cook. | T. L. Jenkins, Esq. |
| A. H. Leith, Esq. | J. Ritchie, Esq. |
| J. Harkness, Esq. | M. Stovell, Esq. |
| H. L. Anderson, Esq. | C. J. Erskine, Esq. |

*Museum Committee.*

| | |
|---|---|
| A. H. Leith, Esq. | H. J. Carter, Esq. |
| T. L. Jenkins, Esq. | G. Buist, Esq., LL.D. |
| J. Harkness, Esq. | R. S. Sinclair, Esq. |

*Auditors.*

Captain J. G. Forbes. H. B. Gilmore, Esq.

It was resolved that the "Cape Town Mail" should be discontinued and the "Cape Monitor" taken in its stead; also that the "North British Review," the French and English "Illustrated News," and the "Economist" should be added to the list of periodicals.—*27th Nov.* 1854.

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FROM THE 27TH NOV. 1854 TO THE 26TH NOV. 1855.

The following letter from W. E. Frere, Esq., was read:—

MY DEAR DR. CARTER,—I must beg you to allow every consideration for an invalid, and one on the point of leaving India, and pardon my great neglect in not having written you till this moment to beg you would lay before the Anniversary Meeting my resignation of the office of President.

It is with great regret that I resign it after so short a tenure of office, and without having been able to do one single thing for the benefit of the Society.

I commenced to make some progress in the arrangement of the coins, but was unable to complete it. If however, when in England, I can do anything for the Society, I shall rejoice in the opportunity, and I still hope, on my return, that in an inferior situation I yet may be permitted to do all in my power to aid the Society, whose interests I beg to assure you I have very much at heart.—Believe me, &c.

(Signed) W. E. FRERE.

Malabar Hill, 27th Nov. 1854.

It was then proposed by the Rev. Dr. Wilson, Honorary President, seconded by Dr. Stovell, and carried unanimously:—

"That the Society record its great regret at having been so soon deprived of Mr. Frere's valuable services, and especially that this should have been occasioned by illness; also its hope that at the expiration of Mr. Frere's intended residence in Europe he may return with full restoration of health to realize that hope, so kindly expressed in the concluding part of the note tendering his resignation."*

In answer to Professor Eastwick's letter, presenting the copy of his work above mentioned (p. 648) it was resolved:—

* As Mr. Frere's letter, by accident, did not arrive until after the business of the Anniversary Meeting had been concluded, it was read at the following Meeting, and the above "Resolution" recorded, but no one elected to succeed him, for the reasons stated at p. 688.

"That in communicating the best thanks of the Society to him for his valuable present, Professor Eastwick should be informed that the copies of the Society's Journal formerly sent through him, at his request, to the Library of the Hailybury College and the Berlin Library, should be considered as presents, and that the rule passed at the Anniversary Meeting of 1853, mentioning the sum that should entitle members to a copy of the Society's publications, should be forwarded to him in reply to that part of his letter proposing an arrangement of this kind regarding himself.

*Description of the Caves of Bagh in Rath, with drawings.* By E. Impey, Esq.*—Dr. Impey states, that "although the caves of Bagh in Rath were described by Lieut. Dangerfield, an amended and more detailed description has become necessary from the author's discovery of several large Vihars in connection with them, and from their peculiarities as a series, which is perhaps as perfect as any brought to light heretofore, and in magnificence and size surpasses even Adjunta, that is as far as they extend.

"The defect in them has been the absence of a *Temple-Cave* or *Chaitya*, but is remedied by the object of worship (the Daghoba) being placed in a chamber by itself in the rear of the cave, which is remarkable and a departure from the general practice of the Buddhists; but seems peculiar to Malwa, where image-worship was little resorted to; the Daghob—as representing the relics of Buddh, being the principal object of adoration, as in the caves of Dumhar and those recently discovered by the author at Koolvee, derived probably from the presence in the country (at Sanchi) of the Great Stupa,—the purest type of the Buddhist religion in its orignal state.

"Another peculiarity in these caves is that of a large dome or cenotaph in the principal one, which is very singular, but indisputable. From the comparative insignificance of the Daghob in the rear, it is not improbable that there was a larger one under the dome, but it is left to conjecture entirely to supply a receptacle, for the debris of the roof have entirely choked it up.

"There are evidences also of a large colonade, 220 feet long, supported by 20 pillars 14 feet high, with painting in bright colours covering the surface of the verandah behind and extending over the fronts of a Vihar and school-room or banqueting hall, which is the most perfect of its kind known, and is connected with an assemblage of cells differing from all others, which seem to have been set apart for titular superiors.

* See this "Paper" *in extenso*, p. 543.

"The caves are cut in a sandstone formation of a soft nature, and the paintings consequently supply the place of sculpture, both interiorly and exteriorly. They are considerably defaced and were only brought to light by varnish. They are divided into compartments representing sets of dancers and musicians, and of horses and elephants, in procession towards a figure of Buddh seated in an arbor in the attitude of expounding, and probably were meant to refer to the consecration of the cave and of the relic shrine.

"That their comparative size may be understood, the proportions of other known Vihars are then given as follows:—

| | | | |
|---|---|---|---|
| No. 16 at Adjunta | ..... | 67 feet by | 65½. |
| „ 17 „ | ..... | 64 „ by | 63. |
| „ 1 „ | ..... | 64 „ | square. |
| Keneri Vihar | ..... | 96 „ by | 42. |
| No. 2 at Bagh | ..... | 94 „ | square. |
| „ 1 „ | ..... | 88 „ | „ |
| „ 5 „ | ..... | 86 „ | „ |

"The Dherwarra at Ellora is 110 per cent. but this includes the side cells, and 18 feet being deducted (9 to each), the remainder 92 proves it to be less than the Bagh Caves.

"In respect to the dates of these caves, the author conceives that they were excavated in the reign of Chandragupta, who ruled in Malwa in the 4th century A. D., under the cognomen of Vicramaditya the Second, and according to Prinsep's and Cunningham's reading of the Sanchi inscriptions, was a most liberal supporter of the Buddhists. This date is adopted in preference to the later one assumed by Mr. Fergusson, of between 6th and 10th centuries, both from the known decline of Buddhism at the later period, the persecutions of the Buddhists by Shankar Acharya in that century, and from the reign of Siladitya, the only Buddhist prince of note in Malwa in the 7th century, being chiefly occupied with war and conquest; in addition to which, it is to be presumed that the worship of the Buddhists at that period would have shown more corruption and admixture of Brahminical emblems; whereas, in the paintings, sculpture, and objects of worship, the Bagh Caves bear strong similitude to those at Sanchi, which are considered emblematic of all that is pure in Buddhism.

"The author conceives that the gradations of cave-architecture are deceptive sources of chronologic accuracy or classification, and that different eras are rather characterised by differences in decoration and delineation of figures than by execution, in fact rather than by any

variety of design or propotion in the caves themselves, which is common with Indian architecture generally, that is, devoid of any architectural pretensions; massiveness and decoration being the chief features of art with them, the former in a measure imposed on them from the nature of their work and the preponderance of weight, and the latter designed to relieve and carry off the defect of the first.

The author also conceives that the caves were designs from *structural* buildings, from the appearance of streets and cross beams in the roofs. Vihars in Ceylon having been built in the 1st and 2nd century B. C., and also those ordered by Asoka in India about the same period, which correspond with the Brahminical Maths of the present day.

*Essay on the Sindian Alphabets.* By the Reverend Dr. Trumpp, Communicated by the Reverend Dr. Wilson.—In laying Dr. Trumpp's paper on the Sindian alphabet before the meeting, Dr. Wilson remarked that it was composed with a full recognition of the true principles of oriental philology. The Sindian, Dr. T. considers a genuine Arian language. Its ancient Indian alphabet was perfectly suited for its expression, till, by the Mahomedan conquests, a large stock of Arabic and Persian words, amounting to about a fifth of the whole language as it now exists, was engrafted upon it. "The Musulmans, Dr. Trumpp writes, in their sovereign contempt of the Hindús, disdained to adopt an alphabet from their subjects, and transferred the holy letter of the Koran to the uncouth tongue of Sindh. The few, who attempted to write in Sindhi, were compelled to load the Arabic alphabet with a confusing heap of dots and other diacritical marks. The Hindús on the other side declined to augment their present store of letters with new ones, or diacritical marks, which had become necessary by the introduction of Semitic words, for the expression of those sounds they possessed no adequate letters. The consequence was, that their respective writing remained hieroglyphic to each other, and the Hindús in particular had no reason to wish for publicity of their writing (which, however, was restrained to their mercantile accounts), as their hieroglyphic character was rather a protection against the avarice of their bigotted Moslem rulers. It is, however, self-evident, that if knowledge shall be spread amongst Hindús and Musulmans, one of the two alphabets must admit the words of the strange tongue within its pale, and which alphabet would best be adapted to give the exact sounds, we will elucidate by comparing the different alphabets." After reviewing the Sanskrit, Arabic, Persian, Sindian, and Hindustani alphabets, Dr. T. determines in favour of the last men-

tioned as capable of expressing the peculiarities of both Indian and Arabic words.

*Report on Meteorological Observations made during a Voyage from Southampton to Bombay, between the 20th of September and the 26th October* 1854. By A. Schlagintweit, H. Schlagintweit, and R. Schlagintweit, Esqs. Communicated by the Secretary.—The Report by the Messrs. Schlagintweit consists of tables of observations on the temperature and specific gravity of the sea-water at different depths in the Atlantic and other seas, through which they passed on their way from England to Bombay; and the authors promise a further report on the temperature of the air and on the moisture in different elevations above the level of these seas, as well as of the two experiments which they made in the Mediterranean and Red Sea on the quantity of carbonic acid contained in the atmosphere of these two localities.—*28th December* 1854.

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Resolved—"That the *Secretary* be requested to inform Messrs. Smith, Taylor, and Co., and Messrs. Thacker and Co., of the yearly expenditure of the Society for books, and to request the favour of them, respectively, to furnish terms on which they could supply the Society."

Resolved—"That the letter No. 702, dated 17th February 1855, from the Secretary to Government, General Department, with enclosed despatch No. 59, dated 29th December 1854, from the Honorable the Court of Directors, be handed over for the information and guidance of the Cave-Temple Commission."

The Honorable Court, in their despatch (No. 59 of 1854), comment on the great expense which the entertainment of Mr. Fallon for planning and illustrating the Cave-Temples and their sculptures has entailed, also the expense attending the employment of Mr. Brett to copy the Cave-Temple Inscriptions, and request that, at the expiration of Mr. Fallon's present engagement, photography may be substituted for both these purposes.

The Honorable Court also mention that Captain Biggs, of the Bombay Artillery, is an excellent photographist; and the Government, in accordance with their recommendation, have been pleased to appoint this officer to succeed Mr. Fallon in June next.—*22nd Feb.* 1855.

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A Special Meeting of the Society was held in its library, on Saturday the 7th April 1855, for the reception of Lieutenant-Colonel

Rawlinson, C.B., and to afford him an opportunity of giving a *vivâ voce* account of his latest researches and discoveries in Assyria and Babylonia.*—*Sp. M. 7th April* 1855.

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The letter, accompanied by the volumes of the Transactions of the Wisconsin State Agricultural Society, (mentioned under the head of Presents for the Library) requesting that in return it might be presented with copies of the publications of the Bombay Branch of the Royal Asiatic Society—

It was resolved, that a complete copy of the Journal should be forwarded to the Wisconsin Society by the first opportunity, with a letter of thanks for their Transactions, and accepting their proposed terms of exchange.

With reference to the question of transferring the Book-business of the Society from the London Booksellers to a Bookseller in Bombay, the *Secretary* stated, that in accordance with the proposition of the Society passed at its meeting held on the 22nd February last, Messrs. Smith, Taylor, and Co. and Messrs. Thacker and Co. had been addressed on the subject, and that letters containing their terms respectively had been received.

These letters were read, and after some discussion the following resolution, proposed by T. L. Jenkins, Esq., seconded by the Rev. Dr. Wilson, was unanimously carried, viz:—

1st. That on account of the increased facility of obtaining books from England and the establishment of Booksellers and Houses of Agency in Bombay, with whom the Society can communicate direct, the Society are of opinion that the time has arrived when the difficulties attending the transactions of this part of their business at a distance can be greatly lessened, and the Society's objects much advanced by availing themselves of the opportunities offered on the spot; and that although they are of course exceedingly unwilling to leave those who have served them with such fidelity and judiciousness as their present Booksellers for so many years past, they nevertheless feel conscious that the changes mentioned (which the shortness of transit has induced) and the advantages to be derived from them, now necessitate their transferring this part of their business to a firm in Bombay.

2nd. That as the terms proposed in the letter from Messrs. Smith, Taylor, and Co. are more favourable to the Society's interest than those of any other applicant, and consignments of the Society's

* See p. 478.

Journal for sale have for some years past been in the hands of Smith, Elder, and Co., of whom they are the Agents,—Messrs. Smith, Taylor, and Co. be appointed the Society's Booksellers, and the Committee of Management requested to make the necessary arrangements for transferring their Book-business from the London Booksellers to this firm, with as little delay as possible.

With reference to the election of *President* and *Vice-Presidents*, it was proposed by the Rev. Dr. Wilson, seconded by Dr. Arbuckle, and carried unanimously—

"That on account of the short time that would elapse before the return of Mr. Frere, and the great interest he took in the Society's affairs rendering it desirable that he should be re-elected, the election of *President* be postponed until his return, or until the Anniversary Meeting of the Society in November next: also that the election of the *Vice-Presidents* be deferred until that time.

The propositions of Mr. Erskine for admitting the Graduates of the Grant Medical College and first Students of the Elphinstone Institution to certain privileges of the Society gratis, having been brought forward—

It was proposed by C. J. Davies, Esq., seconded by Captain J. G. Forbes, and carried unanimously, that as they involved an alteration of the fundamental rules of the Society, their discussion should be postponed until the Anniversary Meeting.

*Remains of Buddhist ornamental Architecture in Sinde.*—Among the fragments of *terra cotta* ornaments mentioned in the presents to the Museum* are a figure of Buddh in a sitting posture with the legs drawn up; a head with a curled wig similar to those seen in the caves of Elephanta; an elephant's head; and figures of the lotus, together with fragments of cornices. Of these ornamental remains Mr. Frere states as follows:—"We found them in several spots from Syudpoor, about half-way between Moolakattyar and Mahomed Khan's Tanda, to Sidh Soodemu, where the ruins of a tower is situated, built of unburnt brick faced with large burnt bricks, at the junction of the Goonee and Fullailee, about six miles north of Mahomed Khan's Tanda. This we were told was the ruins of a light-house, which existed here when the sea came up the Goonee and ships used to come hither, and was built by the Bẽni Israel, in the time of the Prophets, before the days of the Kafir kings."

* Page 665.

The specimen of Nostoc mentioned in the presents to the Museum, which very much resembles *N. collinun*, Kg., was sent to Mr. Frere by Lieutenant Cowper, Acting Collector Shikarpoor, with the following note:—

"I send you herewith a small specimen of a substance said to have fallen last month in Boondika, just a little beyond the Bigaree Canal. The weather was showery at the time, and the substance was pretty thickly strewed over a space of two or three miles square. The Natives described it as a shower of "*gosht*" (meat) which they said it resembled, being, when fresh, of a soft pulpy consistence and like flesh in colour."

The Secretary stated that this substance, now consisting of dry and shapeless fragments, would, after having been placed in water for a few hours, resume its natural gelatinous form, and thus reveal its true character. It was an Alga called *Nostoc*, not far removed in the vegetable kingdom from the sea-weeds, which are frequently boiled down into jelly for food, and in China, as well as in some other countries, certain species of *Nostoc* were commonly eaten. The Sindians were, therefore, not far wrong in calling it *gosht* or meat; and from the inconceivable smallness of the germs from which it is first generated, like the green which makes its appearance over objects that have never been exposed to the monsoon, yet present this colour a few days after it has commenced, the germs of this *Nostoc* might have been brought through the air to the place where they at the appointed time for their germination passed into visible forms, which having no earthly origin that the ignorant Sindians could conceive, and coming into tangible masses just after a storm, not unnaturally led to the conclusion that they must have been showered down from the heavens. Happily many of these events which appeared miraculous to the ignorant for some wise purpose, and give rise to scepticism among many at the present day because they are not understood, derive explanations from Science which defy all attempt at disbelief. It was wonderful to the Sindian to see what he could only conceive to be a substance rained from heaven; it is not less wonderful to the Naturalist, who can trace this substance to its germs, to wonder even still more how these were first generated and how they go on uninterruptedly and unerringly producing their like. Thus does the Creator keep up his power of eliciting wonder and admiration from the most ignorant to the most learned!

Of the collection of geological specimens and fossils from Berbera above mentioned, Lieutenant Burton states that the latter are chiefly found on the plain of Berbera, and the former, in the following order,

between the sea and the summits of the mountains (600 feet high) above it; that is, the ridge immediately behind Berbera.

"1st. Country along the coast consists of a Coraline Limestone (Tertiary Formation?) with drifts of sand, &c.

"2nd. Sub-Ghauts and lower ranges (say 2000 feet high) of Sandstone capped with Limestone, the former proponderating.

"3rd. Above the Ghauts a plateau of Primitive Rocks mixed with sandstone, granite, syenite, mica schiste, quartz rock, micaceous grit, &c."

The fawn-coloured fossils from his Coraline Limestone are evidently the same as those of the tertiary formation along the SE. coast of Arabia, and therefore the same as those of Cutch; and it is exceedingly interesting to find that among the blue-coloured fossils, which are accompanied by specimens of the blue shale composing the beds from which they have been weathered out, are species of *Terebratula* and *Belemnites*,* identical with those figured in Grant's Geology of Cutch.—14*th June* 1855.

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The Committee of Management having met, in accordance with the resolutions of the Society passed at their Meeting held on the 14th June last, respecting the transfer of their Book-business from the London Booksellers to a Bookseller in Bombay, resolved:—

I. That letters be written to Messrs. Longman and Co. and Mr. J. M. Richardson, respectively, forwarding—1st, A copy of the Society's resolutions respecting this transfer. 2nd, Stating their desire, if convenient, that the transfer should be made on the 1st of January 1856. 3rd, Requesting that any arrangements that they had already made, which could not be conveniently closed by the end of the year, might be continued, the same being made known to the Society by return of post if practicable; and 4th, Stating that Messrs. Smith, Taylor, and Co., in Bombay, would be prepared to take on the supply of the Society with books and periodicals from the 1st January 1856. (See letter in Letter Book, No. 49, dated 29th July 1855).

II. That Messrs. Smith, Taylor, and Co. be informed that the Society would be happy to accept the terms for the supplying of the Society with books and periodicals mentioned in their letter dated 9th March last. 2nd, That a copy of the letter forwarded to Messrs. Longman and Co., and Mr. J. M. Richardson, be also forwarded for the information and guidance of Messrs. Smith, Taylor, and Co. 3rd, That a list of all the periodicals, serial works, and other publications of the kind be

* See a further account of these fossils, p. 638.

forwarded to Messrs. Smith, Taylor, and Co., with a request that they will be prepared to take on the supply of the same from 1st January 1856, as well as that of all other books required by the Society, after the manner and terms expressed in their letter. 4th, That Messrs. Smith, Taylor, and Co. be requested to send in the list of new publications, alluded to in para. 6 of their letter, on the Monday preceding the second Thursday of every month.—16*th July* 1855.

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It having been observed by the Secretary that he had had great difficulty latterly in getting sufficient Members present to form a quorum for the election of Members;

It was proposed by Colonel Jacob, seconded by C. J. Davies, Esq., C. S., that the following proposition should be brought before the next Anniversary Meeting:—

"That on account of the difficulty of obtaining a sufficient number of Members to form a quorum for the election of gentlemen proposed as Members of the Society, votes on such occasions be allowed to be tendered by written proxy addressed to the Secretary."

Specimens of *Phyllium siccifolia* with eggs, were laid before the Meeting by Colonel LeGrand Jacob, who had brought them from Batavia in Java.

Colonel Jacob stated, with reference to the Island of Bali, that Mr. Friederich, the Secretary of the Batavian Literary and Scientific Society, believed it to have been colonized from Java, and not directly from India, only a short time before the fall of its last Hindu kingdom at Majapahit, an event of comparatively recent occurrence. This is Mr. Friederich's main reason for thinking the "Bali" of the copper-plate inscription formerly given to the Society by Colonel Jacob, not to mean this island.

Respecting some coins belonging to His Highness the Rao of Cutch, which were dug up in Cutch just before Colonel Jacob's departure for Australia, and which he stated he had taken with him for decypherment, he observed, that one set were of the late dynasty termed *Sáh* (in which he read *Sasa* sometimes curtailed to *Sa*), which dynasty reigned a century or two B. C.; the others were "Guptas" perhaps of the same dynasty, but reigning at a very doubtful time after.

Colonel Jacob also stated, that at the next Meeting of the Society he would present Mr. Friederich's translation of the Sumatra and Java inscriptions, referring, the first plainly, the second obscurely, to the union of the *Sivaistic* and *Buddhistic* faiths.

Java, he observed, abounded with relics of Hinduism in both of these forms, and was a most interesting country for an Indian antiquary, but the adjoining Island of Bali is still more worthy of note, exhibiting as it were a piece of India chipped off at some remote period from the continent, and since kept as separate as Herculaneum from modern Italy. There, Hinduism is found in its four great divisions, the practice of Sati, and the Hindu scriptures in another tongue; but Colonel Jacob would not enlarge on this interesting subject further than to express surprise that so little attention has been paid to it by Anglo-Indians.—*13th September* 1855.

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The Rev. Dr. Wilson, *Honorary President*, Colonel Jacob, and Brigadier J. Hale having proposed Mr. R. H. Th. Friederich, Secretary to the Batavian Literary and Scientific Society, as an Honorary Member of the Society, the ballot for that gentleman's election will be held at the next Meeting, in accordance with the rules of the Society.

Colonel Jacob, seconded by Dr. Wilson, also proposed—

"That the thanks of the Society be tendered to Mr. Friederich, for the books formerly presented by him through Colonel Jacob to the Society, as well as for the translations, &c. of the inscriptions from Sumatra and Java now on the table; also, that a complete copy of the Society's Journal be forwarded in return to Mr. Friederich, by the earliest opportunity; and that at the same time the Society's hope be expressed that he will continue to favour them with similar communications, for which Bali especially, and the Dutch possessions generally, in the Eastern Archipelago, offer such an interesting field for research. Further, that the hope be expressed that Mr. Friederich will turn his attention to a publication with translation of the *Brahmánda Purána* of Bali, in which work the Society feel a deep interest, and would be happy to second his labours in this respect to the extent of their power." This proposition was unanimously carried.

*Ruins found in the bed of the Narra.*—Captain Kirby states that in excavating the great Narra Canal about two miles and a half from the town of Roree, the foundations of a number of houses were laid bare; they were about ten feet below the surface, and composed of stone-work alone or mixed with bricks.

In proceeding from Roree, the first of the ruins met with consisted of a large wall, about four feet thick, which extended from one side of the canal about 100 feet inwards. This wall, which was built of bricks,

Captain Kirby thinks might have been part of the old town-wall. From this point foundations of houses extend south-easterly for 700 feet. Amongst the ruins were found several articles made of brick-clay, such as drinking cups, a water-jar, some water-spouts, and a large number of children's toys. There were also found some round stones, which appeared to have been used as weights; one was equal to two chittacks, another to four, and a third to six.

The town appears to have been built on the extremity of a rocky hill, and to have been "gradually" covered by mud held in suspension by the waters which deposited it. The burial-ground still remains uncovered. Huckrah would appear to have been the name of the town, which is still retained by a village in the neighbourhood.

The Secretary then read an extract from a letter from the Rev. J. Murray Mitchell, enclosing one from Professor Spiegel of Erlangen, to his address, respecting his recent investigations into the ancient languages and literature of Persia.

Dr. Wilson regretted much that the interesting communication of Professor Spiegel* had incidentally come before the Society at a meeting pledged by its circular to give its principal attention to the matters to be submitted to it by their able and zealous member, Colonel Jacob; for many of the topics to which it briefly adverted were worthy of particular notice. With other papers which he had lately observed, it afforded hopes that the time was fast appoaching when there would be only one opinion entertained among Orientalists about the various questions which had been raised about the languages and literature both of Eastern and Western Irán. He was sorry that Mr. Spiegel had not entered into explanations with their venerable associate, Mr. Romer, for certain he was, that he would have encountered no lack of courtesy or philological appreciation in that quarter. He the more readily expressed this conviction that he (Dr. W.) did not take the same view of the *Avastá* language that does Mr. Romer, by whom its genuineness is suspected on the ground of its close resemblance to the Sanskrit, on the basis of which he held it was fabricated by the Párs̀í Priests. Mr. Romer had already got considerable relief in his difficulties by the admission of Orientalists that the "Old Persian" was "not the offspring," but a "sister or cousin" of the *Avastá* language, commonly called Zend; while, on the other hand, his suspicions were confirmed by the doubts which were thrown over the language of the translations of the Zend, sometimes called Pehlvi or Huzvarish. To this transla-

* Page 492.

tion-language, Mr. Spiegel's inquiries, it would appear, have been lately directed; and all due attention would be given to his researches and their results. One sentence of his letter was well worthy of attention:—"I am not of the opinion that the Pehlvi language was ever spoken in the form we have before us." This opinion is certainly correct, if the mode of reading that language (with a very imperfect alphabet and some equivocal letters) resorted to by the Pársís be assumed to be tolerably near the original; but it is also possible to read many of the words in another way, as held by the late Mulláh Firuz and his successor Mulláh Rustamji, by which *many* (not the whole) of the supposed Shemitic words are resolvable into pure Persian, as is the case in the word *Anhuma*, which may be read *Hurmazda*, with its various spellings, without any violence to its literal forms. But these remarks were made only with reference to the views of Mr. Romer. On matters at issue among the students of the Pehlvi, he (Dr. W.) would perhaps make a few remarks in the paper on Oriental and Physical Research connected with the West of India* which he hoped to be able to lay before the Society at its next meeting. With regard to the "Zend," he had long ago arrived at the conclusion that its primitive seat was Eastern Irán, or Bactria and its neighbouring districts. The system of faith and political institutions unfolded in the Avastá differed in some not unimportant respects from those ascribed to the Persian Empire by the classical writers and the Achæmenian tablets, while they agreed in others; and, as indicated by Professor Westergaard in his highly interesting introduction to the Zend Texts, the publication of which has just been concluded, and by Professor Spiegel in the letter now read, it was only in later times transferred to the West of Persia. It was probably only in the days of Ardeshir Babegán that the collection of the Zend pieces was formed, though some of them were of far more ancient composition, even extending perhaps to the days of Dejoces. The most ancient Avastá pieces, however, are certainly later than those contained in the Indian Vedas, for the grammatical and vocabular archaisms of the Indian Vedas (on which the Reverend Mr. Anderson had just been interrogating him) are not to be found in them, while with many resemblances to the religion of the Vedas, they have their antagonisms to it which show posteriority. The Sun (Asura sometimes) is a god in the Vedas, with only subordinate attention, while he is the chief deity of the Zend writings, endowed with intellectual and moral attributes, Ahuro-Mazdáo (Hormazd), the multiscient Sun or Lord, while in another form he is *Hvarĕ-Kshaeta*, the Resplendent or Ruling

* Page 407.

Sun, or *Khurshíd*. *Indra*, with the highest place in the *Vedas*, is a devil in the Zend writings, in which the Vedic word for *God* is throughout used for *devil*. The *Avastá* refuses to notice the benevolent genii by their original names, though they are the Amsháspands of the Parsis, still denominated and praised according to their supposed qualities; and all this is in protest against the growing gross idolatry of the Indians. With most of the minor gods of the *Vedas* the *Avastá* had not interfered.

On concluding, Dr. Wilson, on seeing so many of his Párśí friends present, expressed his satisfaction that they were not altogether standing aloof from the interesting inquiries to which their literature is giving rise. Mr. Dhanjibhái Frámjí had practically evinced his willingness to co-operate with his European brethren by publishing a brief grammar of the Pehlvi as commonly read by the Párśís. The universally respected family of Sir Jamsetjee Jejeebhoy could assist these brethren, by consenting to the publication of the Pehlvi *Wajar-Kard*, which had now been in type for several years, but not yet put into the hands of the public, though individual copies, like one possessed by himself, had found their exit from the stores of the Sir Jamsetjee Translation Fund. That work might do much good in assisting a fair and honest literary criticism, even independently of the more serious religious inquiries which it might raise.

Major Cunningham exhibited to the Society several interesting drawings and fac-similes of Indian Antiquities, the originals of some of which he conceived bore the impress of Greek or Bactrian art. He also left with the Society copies of a valuable inscription at Gwalior which has not yet been deciphered.—11*th October* 1855.

Mr. R. H. Th. Friederich was unanimously elected an Honorary Member of the Society.—22*nd November* 1855.

## ANNIVERSARY MEETING.

MONDAY, 26TH NOV. 1855.

The *Secretary*, at the request of the Rev. Dr. Wilson, *Honorary President*, in the Chair, read the following Report of the *Committee of Management* for the past year:—

GENTLEMEN,—During the past year 13 Resident and 3 Non-Resident Members have been elected.

There have been 167 books and pamphlets presented to the Library; 17 donations to the Museum; and 12 Original Communications have been read at the monthly Meetings.

To the Library 232 works, comprising 356 volumes, have been added by purchase; 305 works, or 318 volumes, consisting of about an equal number of octavos, quartos, and folios, have been rebound, and 14 repaired.

The total number of Periodicals, Newspapers, Calendars, Army Lists, and Almanacs received by the Society has been 92, viz. 53 Literary and Scientific periodicals and journals, of which 23 have been presented by the Societies who publish them; 29 Newspapers, and 10 Calendars, Army Lists, and Almanacs.

Arrangements, in accordance with the Society's resolutions passed at their Meeting held on the 14th June last, have been made with the Home-Booksellers, viz. Messrs. Longman, Brown, and Co. and Mr. J. M. Richardson, for the transfer of the Society's Book-business, on the 1st of January 1856, from their hands to Messrs. Smith, Taylor, and Co. at Bombay, Agents for Smith, Elder, and Co. at London, and letters have been received in reply from the former, of a most satisfactory kind, regretting the change though admitting the reasons assigned by the Society to be conclusive of its expediency.

Comparing the present Report with that of the year before last, we observe a slight increase in the number of Members elected, as well as an increase in the number of books added by purchase and presents to the Library. A greater number of books have been rebound, while the balance in favour of the Society is but a few rupees less.

Your Committee have still to regret that the Catalogue of the Library, though now as far advanced as it can be without the aid of one well acquainted with the publications of ancient and modern Literature and Science, still remains unprinted for want of a person so experienced to conduct it through the press; while no one has been found to undertake the Editorship of the Journal, which the Secretary on account of his numerous avocations has been compelled to postpone.

In conclusion, your Committee would recommend that the Librarian's salary, which is now Rs. 70 (seventy), should be increased to Rs. 80 (eighty) *per mensem*, in accordance with the Society's Resolution passed at its Meeting held on the 10th June 1852, which, not contemplating the delay abovementioned in the printing of the Catalogue after the MSS. and arrangement of the books had been prepared by the Librarian, promised him this increase of his salary at this period.

It was then proposed by Dr. Peet, seconded by Dr. Arbuckle, and carried unanimously—That the Committee's Report be received, and the best thanks of the Society voted to them for their valuable services during the past year.

The *President* and remaining three *Vice-Presidents* of the Society for the past year were re-elected.

The Rev. G. Cook, seconded by Dr. Don, proposed that Professor J. Harkness, should be elected to fill the vacant office among the *Vice-Presidents*, which was unanimously carried.

The following gentlemen were elected for the Committee of Management, Museum Committee, and Auditors for the ensuing year, respectively :—

*Committee of Management.*

| | |
|---|---|
| W. Howard, Esq. | Captain J. G. Forbes. |
| The Rev. G. Cook. | T. L. Jenkins, Esq. |
| A. H. Leith, Esq. | M. Stovell, Esq. |
| Colonel J. Hale. | C. J. Erskine, Esq. |
| H. L. Anderson, Esq. | J. Don, Esq., M.D. |

*Museum Committee.*

| | |
|---|---|
| A. H. Leith, Esq. | H. J. Carter, Esq. |
| T. L. Jenkins, Esq. | G. Buist, Esq., LL.D. |
| J. Harkness, Esq. | R. S. Sinclair, Esq. |

*Auditors.*

| | |
|---|---|
| Captain J. G. Forbes. | Lieutenant J. T. Annesley. |

After some discussion on the "Propositions" of C. J. Erskine, Esq., C. S., for the admission of Graduates of the Grant Medical College and Students of the Elphinstone Institution, free access to the Library gratuitously, they were withdrawn by Mr. Erskine.

The proposition of Colonel LeGrand Jacob for allowing votes to be given by "written proxy" in the election of Members, from the difficulty of obtaining a *quorum* for this purpose, was rejected; 2 having voted for and 11 against it.

It having been proposed in the Circular calling the Meeting that the *Wesminster Review* should be discontinued, 8 voted for and 4 against the proposition, which was thus carried.

Resolved that application be made through the proper authorities for supplying the Society with copies of the "Fort William" and "Fort St. George" Gazettes.

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FROM THE 26TH NOV. 1855 TO THE 24TH NOV. 1856.

With reference to Dr. Buist's letter, drawing attention to the deficiency of local publications in the Society's Library both past

and present, and suggesting that all files of Newspapers, Almanacs, &c. published in the Presidency prior to 1818, should, as far as possible, be obtained; and that a "Reference Department of the Library should be specially provided as a receptacle for new works, newspaper files, &c."

It was resolved, that Dr. Buist's proposition should be submitted for the consideration and report of the Committee of Management.

It was also resolved, on a motion of Dr. Buist, that applications should be made through the proper channels for procuring copies of the "Agra Gazette," "Printed Selections from the Records of the N. W. Provinces," those of Bengal, and those which have not been received of the Bombay Presidency.

A letter from A. Way, Esq., Secretary Archeological Institute of Great Britain and Ireland, was read, relative to an abstract of a communication which Dr. Buist had made to the Society of the Scottish Antiquarians on the "Bows of the Ancients," and submitting for Dr. Buist's opinion a sketch of a bow made of dark-coloured horn, like that of the buffalo, found in the fens near Ely. Dr. Buist was of opinion that this bow (from the description and sketch, which closely resembled an Indian one that he laid before the Society) was "purely of oriental origin, identical with those used in many parts of India, and if so it was a very great curiosity."—*10th January* 1856.

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*Note on Luminous Water in the Sea between Bombay and Aden.* By H. B. E. Frere, Esq.—"About 8 P. M. on the 5th February 1856 we entered a patch of luminous water, and continued sailing through it with little intermission till day-break on the 6th. There were a few intervals of clear water, some of them 6 or 8 miles wide. As we were going about 9½ knots, the patch must have been at least 70 or 80 miles across. Close to the ship, as we looked down perpendicularly, where the water was agitated by the paddles and wake, the appearance was that of a milky fluid, clouding and gradually mixing with the clear water; at a little distance the milky hue seemed more diffused, and 20 or 30 yards off the water appeared of an uniformly milky tint, or as if the whole surface up to the horizon (which was very clearly defined against the dark sky) had been covered with snow. Night clear, and stars bright, with a few fleecy clouds, which had exactly the same pearl-white tinge as similar clouds have at night over a snow-covered landscape. Wind light from the NW. The milky appearance seemed to proceed from an infinite

number of small luminous points, and was rather stronger where the ripple from the ship's bows broke, but there was less than ordinary of the appearance of single brilliant phosphoric lights usually seen at this time of the year in these seas when the water is agitated. A bucket of water drawn up contained, as far as our naked eyes could discover, no greater abundance of phosphoric animalculæ than tropical sea-water generally contains. The luminous or milky appearance ceased as day dawned, and when the sun rose the sea had no other than its usual appearance, unless it were a reddish-brown tinge, which might have been due to the ruddy morning clouds, though I fancied it was more general than it could have arisen from such a cause.

"I have seen something of the same kind twice before. Once about 80 miles from Bombay, in December 1853, when the night was very calm, and the edge of the luminous patch was so clearly defined that the captain of the steamer (*Bombay*) said, if he had not been sure of his reckoning he should have supposed it was a line of breakers. As we approached, the surface was sufficiently luminous to enable us to see further than we could have done with a bright moon half full, and when the ripple from the vessel, or a fish, disturbed the glassy surface, there was a flash of phosphoric light, and you could trace fish by the increased light of the line on which they moved at a depth of several feet.

"The other occasion was during the monsoon, at Manora, when a small patch appeared to be driven against the rocks, and for half the night made the heavy breakers brilliant to an unusual degree.

"At nightfall on the 6th the same appearance was seen, but the water was less milky, or rather the phosphorescence was less uniformly diffused, and there was a much greater proportion of very brilliant lights, both of the small star-like kind and of the masses as large as blubber-fish, of which there were great numbers about the vessel after dawn. The officers of the watch said that with more or less intermission the luminous appearance of the water continued through the night.

"About midnight on the 9th to 10th February we ran into a similar patch, much smaller than the former ones, but remarkable for diffused brightness and freedom from any particular spots larger or more brilliant than the others. The effect was exactly that of a sea of milk. Some clouds on the horizon were relieved against it so distinctly, that every one on deck thought they were the land, then some 50 or 60 miles distant, nor was it for sometime that the captain felt satisfied we had not even drifted in-shore by some unusual current."—*28th February* 1856.

Dr. Wilson, on behalf of the Cave-Commission, reported that at a meeting just held, the Commission had taken into consideration one of the recommendations made to the Society, in the address delivered at its meeting held on the 22nd November last, viz. that the Cave-Commission should take steps for the revision of the cave-inscriptions and their further translation and elucidation; and that they united in the recommendation that the countenance and approbation of the Society should be given to the Commission in an application which it proposes to make to Government that it should be empowered by a monthly grant of fifty Rupees, in the first instance, to retain the services of Vishnu Shastri Bápat, a learned Bráhmán well-skilled in the cave-character and inscriptions, to aid them in their labours in this department.

The Meeting having approved of this measure, requested the Secretary of the Cave-Temple Commission to act accordingly.

Dr. Buist, on presenting to the Society a set of specimens of Trap in process of transformation into Laterite and other substances, made the following observations :—" The singular rock called Laterite is, so far as appears from the writings of geologists, peculiar to India. It prevails all over Hindoostan, the Malayan Peninsula, and the Eastern Archipelago; at all events from the 28th parallel S. I do not recollect to have seen it described as existing northward of the Sutledge, or indeed of Agra, although traps in those quarters are abundant. It is not made mention of as a recognized rock in any part of European America, though it surely might be looked for where a climate similar to that of Hindoostan, and rocks such as constitute our mountain ridges, occur together. Until of late years there has been no distinctly recognised theory of the origin of laterite. The majority of geologists consider it an independent muddy volcanic effusion. The lignite, copalite, and other organic remains found by General Cullen associated with it near Quilon, caused it for a time to be supposed a Neptunean rock, while for ten years back the tendency has been towards the theory of its being a decomposed trap.

" The difficulty of this explanation lies in the fact that laterite of nearly similar character is found prevailing over a great many varieties of rock, occasionally over limestone, as well as over those formations from whose disintegration exclusively it is assumed to be derived. In reality we are only now beginning to appreciate the almost numberless transformations, the decompositions and recompositions without end to which rocks, especially those abounding in iron, silica, and the alkalis are subject. In 1850 Mr. Ebelmen found that one

specimen of trap from Cornwall, consisting essentially of Labrodorite and Pyroxene, lost by decomposition one-third of its silica, five-sixths of its lime, and half of its alkalis. A specimen of basalt from the Rhine lost by the influence of the weather two-thirds of its alkalis, a fourth of its lime, and about an eighth of its silica. These decompositions were attributed by him to carbonic acid and oxygen in the water, or to organic matters alive or in process of decomposition, and the processes thus in progress in Europe with sufficient celerity may be supposed to act with tenfold energy in India. In 1848 my attention was drawn to masses of rocky matter found imbedded everywhere in the red earth overlying our traps, and identical in everything save colour with the true laterite of the Ghâts ;—the latter has a bright red, the former is reddish brown. I prepared and forwarded at the time a paper to Colonel Sykes on the subject, when my faith in my own doctrine was subsequently shaken by a discussion on the subject on the spot, with the late Captain Newbold, an authority so very high, that it was not easy to avoid bowing before it. In 1852, our distinguished Secretary, Mr. Carter, laid before the Society a paper illustrative of the specimens and adopting the decomposition theory. I examined with him the substance *in situ* assumed to be laterite, and I have no doubt correctly. It formed a vein or bed in the black basalt of Worlee Hill, and in all respects appeared identical with the imbedded masses in the red earth of Sewree. Ten days since I had occasion to visit the caves of Kennery in hopes of assisting in solving the question as to the best mode of copying the inscriptions and of obtaining for the Government Central Museum clay or stucco-casts of these as well as of some of the sculptures. Less successful than I had hoped to be in the main object of inquiry, I was eminently fortunate in obtaining a magnificent suite of about a hundred varieties of trap and trappites in various stages of decomposition. The lower part of the Vihar Valley, betwixt the great dam and the high road, is closed in by a mass of diorite, partly dark-blue or greenish, in part ochry-yellow or buff, but all highly crystalline, and very slightly decomposed. Near the site of the great filtering tower there is a mass of black chert, obviously Neptunean rock, petrified, identical with that on which Sewree Fort stands, and this stratifies away along the hills to the westward, filling up a large portion of the channel of the stream near the caves of Kennery. At the spill-water again, where the first turf was cut by the Governor General in January last, a great variety of trappite with several amygdaloids present themselves. Two or three greenstone dykes, beautifully defined and occasionally columnar in structure, stretch across the

valley from nearly north-east to south-west. The great mass of hills around the caves consist of a variety of trappite precisely similar to that betwixt the Powder-Works at Mazagon and the "Mount;" the valley is peculiarly favorable for the study of trappean transformations, the rocks around, with the exception of the chert, being exclusively volcanic, so that all the material encountered, whatever its form, must necessarily be of trappean origin. The excavations forming material for the spill-water embankment exhibit nearly a dozen different kinds of soil, almost as unlike to each other as can possibly be conceived; some are pale ochry green, some rusty colour, others nut or reddish brown; some are bright blood red, rusty red, or brownish red, while the principal material in the valley, about eight feet thick, is obviously the genuine Regur, or black cotton soil of Western India. By the sea-shore we have other transformations, the blue clay constituting our sludge, or that of an earlier date furnishing the lagoon of the flats; or older still the bed containing mangrove roots under the littoral concrete of Mahim Wood and the Esplanade, must needs be of trappean origin, as there has never been any other rock where it exists to form it from. But this again only requires exposure to the sun, air, and rain to be transformed into the nut-brown soil of our rice fields, the little kunkur nodules prevailing in this generally possessing a scrap of oyster or other sea-shell as a nucleus of aggregation. The trap and the trappite specimens from Vihar are in all stages of transformation, the marked colour and singular structure of the laterite being always from the outset developed from certain centres of change. The process of transformation is different in different rocks. Greenstone generally sloughs off first into rusty scales, which change into a brownish or yellowish compact clay, and this again is transformed into the common red earth of our gardens. This latter material alters according to the treatment it receives. Perfectly barren when first exposed to the air, it absorbs carbon with the greatest avidity from any form of decomposing organic matters. It changes its colour from iron red to nut brown; the stony particles which form about three-fourths of its mass disappear, and the whole becomes transformed into a rich fine clay forming the most fertile of our garden soils. Left again to the action of the rain without addition, the finer particles are washed away and furnish the only tolerable refractory potter's earth we possess. The stony particles remaining behind, increase in size and specific gravity by aggregation, assume a shining semi-metallic lustre, and by degrees become united into lumps of solid laterite. Sometimes these various processes are omitted, and in most of the softer trappites, or the debris of the Neptunean rocks of trappean origin

enclosed in them, the transformation is immediate and direct."—13*th March* 1856.

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Mr. Frere stated respecting the coin just mentioned,* cast of which Mr. Gibbs had requested him to present to the Society, and which the latter considered one of Antiochus, that it appeared to be a very beautiful one and more perfect than the one presented by Sir A. Burns to the British Museum, of which there is a drawing in Plate iii. of the 2nd Volume of Burn's Bokhara. The coin is also mentioned in Wilson's "Ariana Antiqua" page 219, as one of Theodotus. Dr. Wilson being of opinion that so long as Theodotus professed obedience to the Seleucidian King, he struck coins in the name and with the device appropriate to Antiochus, and when he declared himself independant he continued the same coin but substituted his own name. Mr. Gibb's coin will therefore be a Bactrian struck by Theodotus (more properly Diodotus) before he revolted from Antiochus Theos and made Bactria an independant kingdom.—8*th May* 1856.

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The Rev. P. Anderson's proposition, viz.—"That it is desirable that a new catalogue of the Society's books should be prepared on a new system, and that for this purpose the Secretary be requested to engage the services of a competent person, offering a sum not exceeding seven hundred Rupees as remuneration for the compiler's trouble"—having been brought forward and discussed, it was moved as an amendment,

"That the words 'Managing Committee' be substituted for the word 'Secretary' in the proposition, and that the words 'Rs. 1,000' be substituted for 'Rs. 700.'" The amendment having been put to the vote and carried unanimously, the original proposition was dropt.—10*th July* 1856.

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Extract of a letter from Professor Spiegel to the Rev. J. M. Mitchell, dated Erlangen, 7th May 1856:—"Since I last wrote to you I have been a good deal occupied, and my labours again have not been without results. The whole of the second volume of my edition of the Avesta-text, Pahlavi translation and all, is in the press, and the printing is going on without interruption. All my time is now spent in the German translation of the work, and the half of it is ready for the press, together with a rather long introduction, on the ceremonies of the

* Page 667.

Parsis. I hope the introduction will not be read without interest. I have been astonished myself by the close resemblance which the greater part of these ceremonies bears to the institutions of the Christian Church in the fifth and sixth centuries. However, there is nothing very puzzling in this fact, for the ancient Parsis, as I have had occasion to state before, studied in the Christian Schools of Syria and Persia. It was quite natural that they should take an interest in the religious discussions of their teachers and apply the results to their own religion, when that was possible. But I scarcely need to tell you that great as the similarity is in some instances, the difference in others is not less striking. My work on the traditional literature of the Parsis, and its connection with the other literatures of the East, will be ready for the press this autumn."—14*th August* 1856.

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## ANNIVERSARY MEETING.

### MONDAY, 24TH NOV. 1856.

The *Secretary*, at the request of the *President*, read the following Report of the Committee of Management for the past year :—

GENTLEMEN,—During the past year 18 Resident, and 5 Non-Resident Members have been elected.

There have been 249 books and pamphlets presented to the Library; 13 donations to the Museum, and 8 Original Communications have been read at the monthly Meetings. To the Library 287 works, comprising 505 volumes, have been added by purchase; 167 works or 590 volumes, consisting of about an equal number of octavos, quartos, and folios, have been rebound and repaired.

The total number of Periodicals, Newspapers, Calendars, Army-lists, and Almanacs received by the Society has been 95, viz. 56 Literary and Scientific, of which 23 have been presented by the Societies, and 10 Calendars, Army-lists, and Almanacs inclusively.

This shows an increase over last year in the number of Members, both Resident and Non-Resident, who have been elected; a great increase in the number of donations to the Library, and a coresponding increase in the number of volumes purchased, bound and repaired; but there is a decrease in the number of presents for the Museum and the Original Communications have been unusually few compared with former years. The great increase to the Library has been through the purchase of Botanical books belonging to the late Dr. J. Stocks, which having been sold at auction in Bombay, enabled the Committee to supply the deficiences in the "Class of Botany" at a very small expense compared

with that which the valuable books thus obtained would have cost in any other way. With reference to the printing of the new Catalogue, your Committee have received tenders for carrying this into effect, and trust that in a few months hence it will be completed. A good part of the XXth number of the Journal has passed through the Press, and it is hoped that it will be completed by January next.

The Report was accepted, and the best thanks of the Society voted to the Committee of Management for their valuable services during the past year.

The following Office-Bearers were elected for the ensuing year :—

*President.*

W. E. Frere, Esq., C. S.

*Vice-Presidents.*

| | |
|---|---|
| Maj. Genl. Waddington, C.B. | Rev. P. Anderson. |
| Hon'ble A. Malet. | John Harkness, LL.D. |

*Committee of Management.*

| | |
|---|---|
| A. H. Leith, M.D. | Rev. G. Cook. |
| Captain J. G. Forbes. | J. Don, M.D. |
| T. L. Jenkins, Esq. | E. I. Howard, Esq. |
| C. J. Erskine, Esq., C. S. | T. S. Cowie, Esq. |
| H. L. Anderson, Esq., C. S. | W. C. Coles, M.D. |

*Museum Committee.*

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| A. H. Leith, M.D. | H. J. Carter, Esq. |
| T. L. Jenkins, Esq. | G. Buist, LL.D. |
| J. Harkness, LL.D. | R. S. Sinclair, LL.D. |

*Auditors.*

| | |
|---|---|
| Captain J. G. Forbes. | Lieutenant J. T. Annesley. |

Upon the proposition of Dr. Sinclair, the "Cambridge and Dublin Mathematical Journal" and "London University Journal" were added to the list of periodicals.

*Patron.*

The Right Hon'ble JOHN LORD ELPHINSTONE, G.C.H.

*Honorary President.*

The Rev. JOHN WILSON, D.D.

*President, Vice-Presidents, Committees,* and *Auditors,* as in the foregoing page.

*Secretaries.*

H. J. Carter, Esq. | R. S. Sinclair, LL.D.

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1845 Le Marquis de Ferriere de Vayer.
1848 Le Vicomte de Kerckhove, Antwerp.
„ M. Eugene de Kerckhove, ditto.
„ M. Felix Bogaerts, ditto.
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„ Colonel LeGrand Jacob.
„ Dr. F. Harrison.
1835 John Harkness, LL.D.
1838 C. Morehead, M.D.

* The figures mark the year of election.

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[The * denotes that the Member has paid the final Donation of Rupees 50, which entitles him to a copy of all future publications of the Society, including the Journal.]

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1852 R. H. Barnett, Esq.

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